NATIONAL ENERGY EFFICIENCY DATA-FRAMEWORK

Summary of analysis using the National Energy Efficiency Data Framework (NEED)

June 2018

Contents

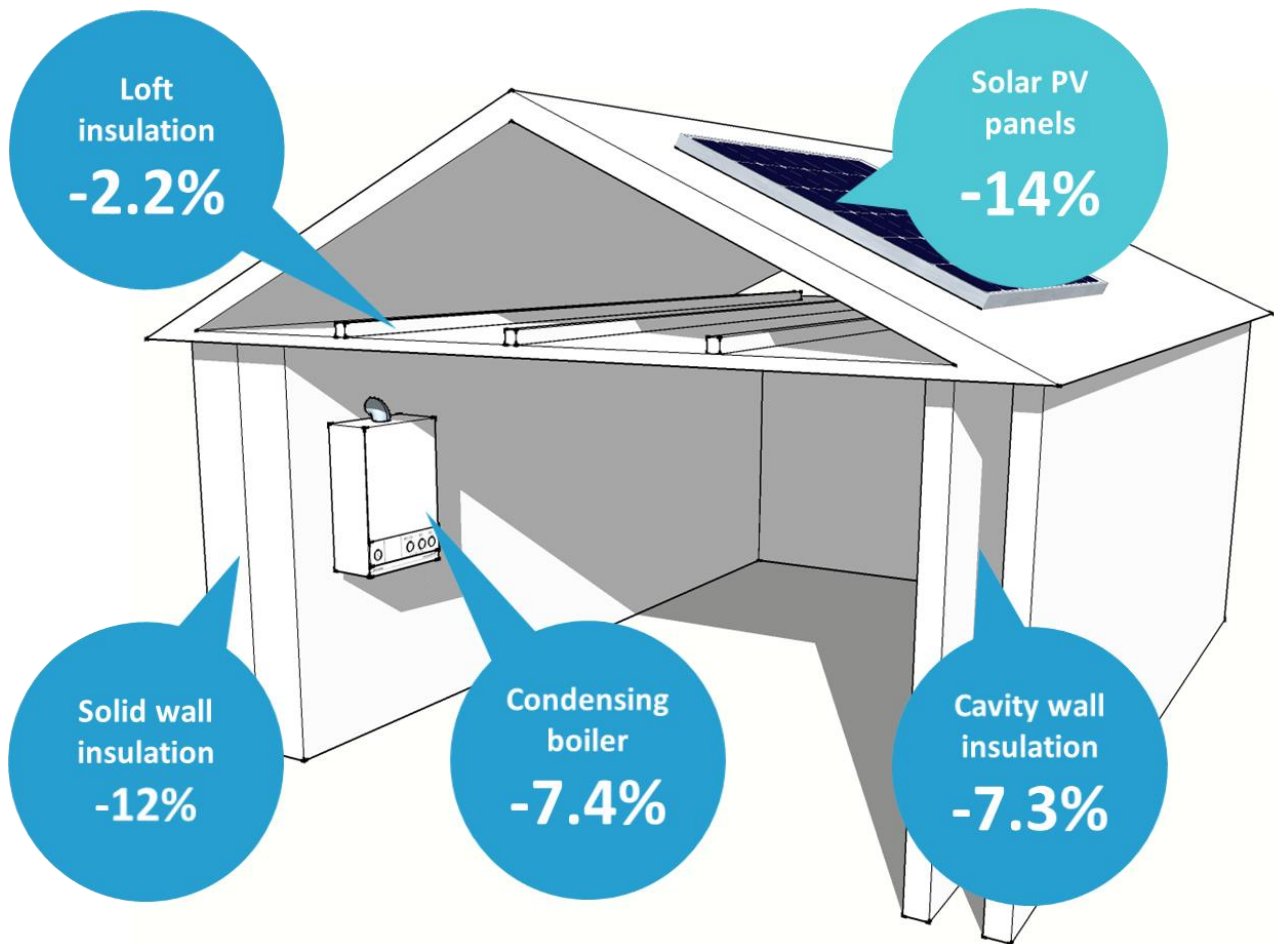# 1. Executive summary

Figure 1.1: Typical savings from energy efficiency measures installed between October 2014 and September 2015

The National Energy Efficiency Data-Framework (NEED) was set up by DECC (now BEIS) to provide a better understanding of energy use and energy efficiency in domestic and buildings in Great Britain. This publication presents:

- Analysis of domestic gas and electricity consumption in 2016 by property attribute, household characteristic, geography and socio-demographic classification
- Analysis of the impact of installing energy efficiency measures between 1st of October 2014 and 30th September 2015 on a household's gas consumption

All results produced for this report are for annual consumption based on a representative sample of data for England & Wales unless stated. Results are produced using the

methodology outlined in the domestic NEED methodology note published alongside this report[1].

Domestic consumption

Chapter 3 presents evidence of how energy is used in households, with mean and median consumption statistics broken down by various property characteristics. For example, Figure 1.2 below shows that the mean gas consumption of households increases with the household income.

Figure 1.2: Mean gas consumption (kWh) between by Household Income, 2016 gas period
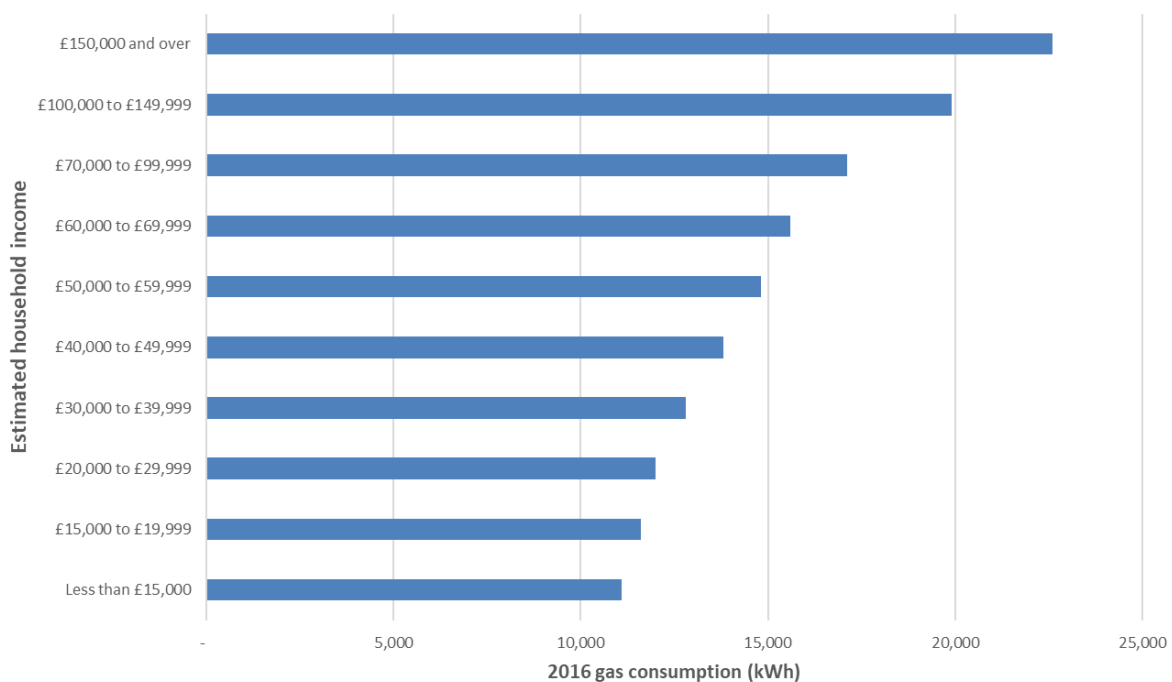
Domestic consumption tables are published alongside this document, showing gas and electricity consumption by various features. Full details of these are in the Overview of Data Tables annex published alongside this report.

Although some of the variation in gas and electricity consumption can be explained by variables contained within NEED, there are other factors to consider, for example differences in building construction, differences in performance of heating systems and appliances, and differences in behaviours of individuals in each household in each year.

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[1] https://www.gov.uk/government/publications/domestic-national-energy-efficiency-data-framework-need-methodology

New gas meter measure method

The summer of 2017 saw the implementation of new gas meter point management and settlement processes, which caused a change in the period covered in gas consumption for the 2016 data. For the previous year (2015 gas year) the average meter read period was October 2014 – September 2015. For this year it is July 2016 – July 2017, a movement forward of almost 22 months, rather than the usual 12 months. Figure 1.3 shows the distribution of the latest meter read dates for this year's gas consumption figures.

Figure 1.3: Count of gas meter reads used in 2016 consumption figures by month
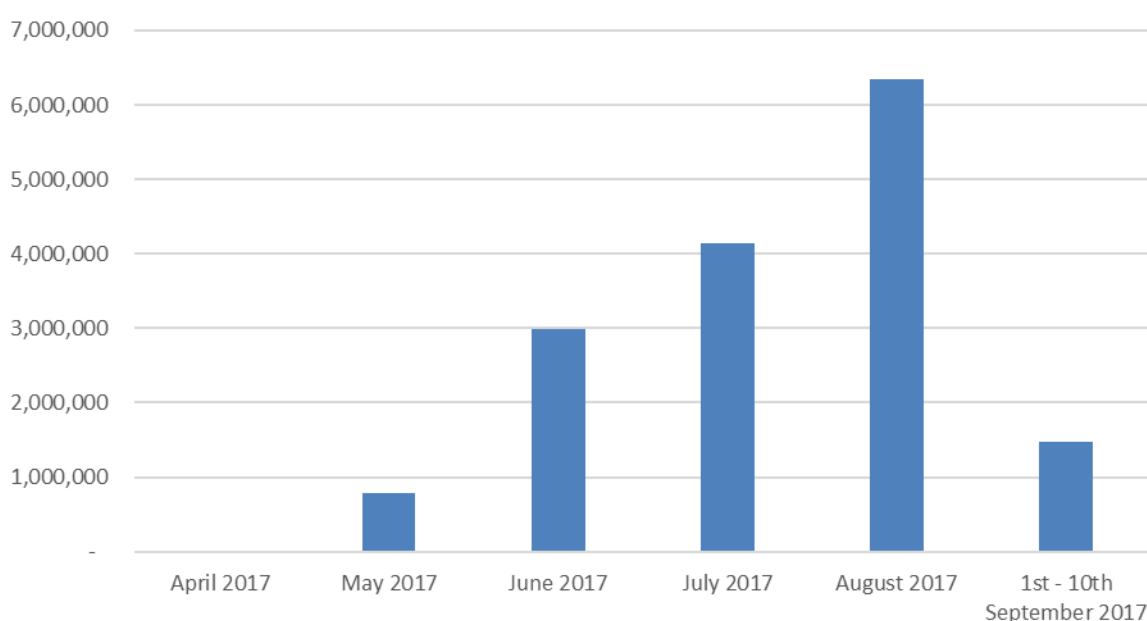
The gas consumption periods each year refers to are:

- Prior to 2014: same October – September period as 2014 and 2015
- 2014: October 2013 – September 2014
- 2015: October 2014 – September 2015
- 2016: Mid July 2016 – Mid July 2017
- 2017 (expected): Mid June 2017 – Mid June 2018
- 2018 (expected): Mid June 2018 – Mid June 2019

From here on in this report the gas consumption periods will be referred to as the year's "gas period" (eg: the 2016 gas period refers to Mid July 2016 – Mid July 2017). All references to gas consumption years in this report signify the gas period for that year (eg: "gas consumption 2015" refers to consumption of gas between October 2014 and

September 2015). For gas period next year (2017) the average meter read period is expected to be June 2017 – June 2018, a movement forward of 11 months.

In the years following this, the movement forward is expected to return to 12 months every year, as the transition period ends. The impact of measures analysis will continue as usual during the transition years, however users of the data should be aware of the different periods covered by the consumption values for each year. Note that the consumption values for each year remain weather corrected (the process by which gas consumption values are adjusted to account for that period's weather).

Impact of measures

Chapter 4 presents estimates of the impact of installing an energy efficiency measure on a household's gas consumption. This shows that considerable savings can be made by properties installing a single energy efficiency measure, or a combination (for example cavity wall insulation and loft insulation). Typical single measure savings across all property types are presented above in Figure 1.1. Figure 1.4 below shows the observed percentage savings in gas consumption for different property types installing cavity wall insulation in the 2015 gas period. Details on the method used to find the impact of measures are given in chapter 4.

Figure 1.4: Estimated savings in gas consumption different property types having cavity wall insulation installed between October 2014 and September 2015

Per cent reduction in gas consumption following installation of cavity wall insulation
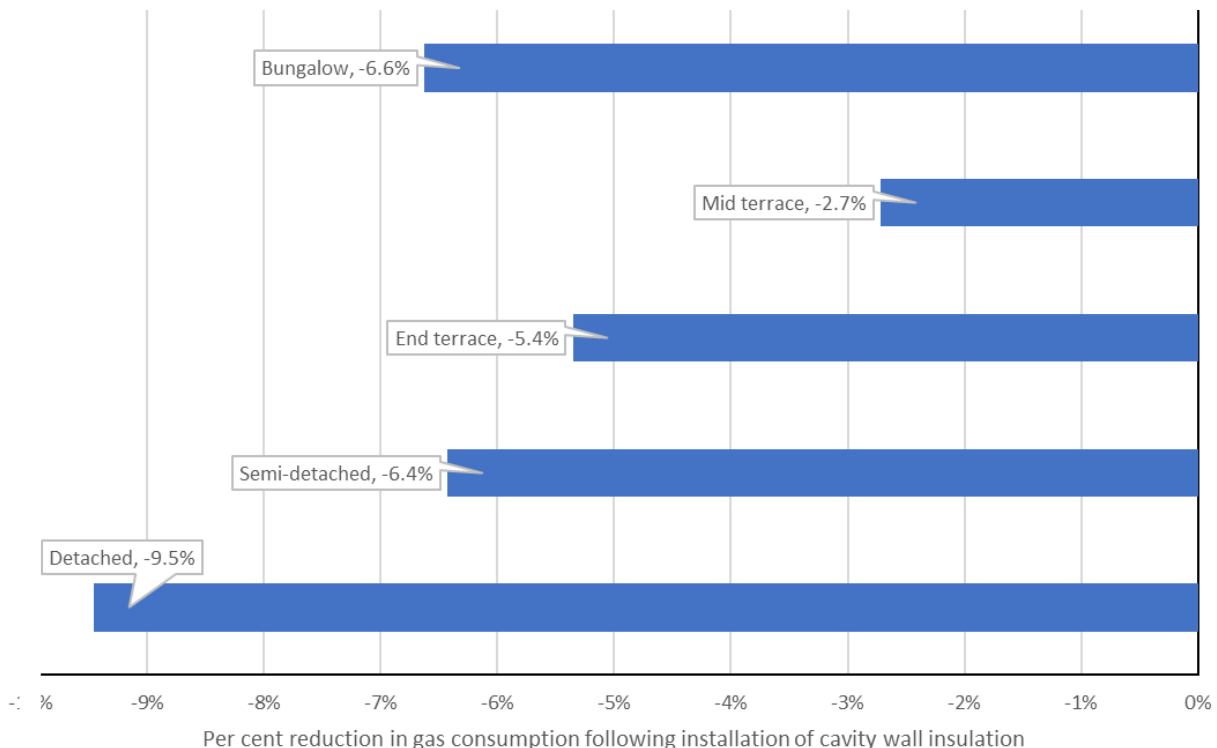
Tables detailing the impact of different energy efficiency measures are published alongside this document. Full details of these are in the Overview of Data Tables annex published alongside this report.

Future uses for NEED

NEED provides a valuable resource and the team recognises potential uses beyond the projects currently taking place. The NEED team is willing to collaborate with external stakeholders to maximise the impact of the data-framework. To get in touch with the team please email: energyefficiency.stats@beis.gov.uk

To maximise the usefulness of future publications, please provide feedback by completing the 1 minute survey linked below:
https://www.surveymonkey.co.uk/r/TJTGZJT

2. Introduction

The National Energy Efficiency Data-Framework (NEED) project was set up by DECC (now BEIS) to assist in its plan to promote energy efficiency and support vulnerable consumers.

It is a key element of the evidence base supporting BEIS to:

- Develop, monitor and evaluate key policies including the Green Deal and Energy Company Obligation (ECO)

- Identify energy efficiency potential which sits outside the current policy framework

- Develop a greater understanding of the drivers of energy consumption

- Gain a deeper understanding of the impacts of energy efficiency measures for households and businesses

The data framework provides the largest source of data available for analysis of consumption and the impacts of installing energy efficiency measures. This report provides updated domestic/household energy consumption results to include 2016 gas and electricity consumption data. It also includes updated estimates of the impact of installing energy efficiency measures on a household's gas consumption for measures installed in 2015.

Headline results and key findings are presented in this report, with detailed data tables including breakdowns by property attributes and household characteristics published alongside this report (see Annex B for details of all published tables). In addition to the domestic consumption and impact of measures tables there are a number of other outputs being published:

- Annex A: Quality Assurance - contains details of the checks and processes followed to ensure the data published is accurate

- Annex B: Overview of Data Tables - contains details of all published tables

- Annex C: Summary of Building Regulations - relating to loft insulation, wall insulation, boiler standards and heating controls

- Annex D: What is NEED? – introduction to NEED and the data it contains

A domestic NEED methodology note has been published alongside this publication, which includes details of how estimates of domestic electricity and gas consumption by property

attributes and household characteristics are produced. It also sets out the methodology for estimating the saving in gas consumption following the installation of retro-fit energy efficiency measures (e.g. cavity wall insulation, loft insulation) and provides background on the users and uses of the data and details of the revisions policy. This note can be accessed from the following link:

https://www.gov.uk/government/publications/domestic-national-energy-efficiency-data-framework-need-methodology

The statistics presented within NEED were previously assessed by the UK Statistics Authority against the Code of Practice for Official Statistics. The UK Statistics Authority published its report on 12 June 2014:
https://www.statisticsauthority.gov.uk/publication/statistics-on-energy-and-climate-change/

The UK Statistics Authority designated these statistics as National Statistics in February 2015, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics.

Designation can be broadly interpreted to mean that the statistics:

- Meet identified user needs

- Are well explained and readily accessible

- Are produced according to sound methods

- Are managed impartially and objectively in the public interest

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

The remainder of this section gives a brief overview of NEED. For any queries or feedback on this publication please email:
energyefficiency.stats@beis.gov.uk

2.1 NEED overview

NEED is a framework for combining data from existing sources (administrative and commercial) to provide insights into how energy is used and what the impact of energy efficiency measures are on gas and electricity consumption, for different types of properties and households. The address information in each dataset is used to assign a unique property reference number (UPRN) to each record. Data from different sources can

then be matched to each other via the UPRN (Figure 2.1). The principle is the same for both the domestic and non-domestic sector, though different data sources are used.

Figure 2.1: Structure of domestic NEED
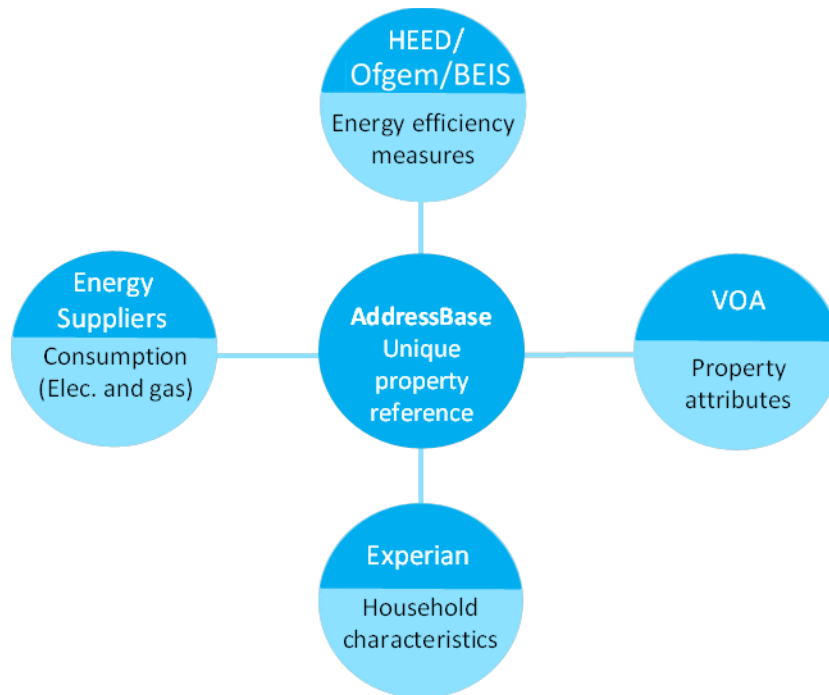
Seven key data sources have been used to analyse domestic energy consumption and the impact of installing energy efficiency measures:

- Meter point electricity and gas consumption data

- Valuation Office Agency (VOA) property attribute data

- Homes Energy Efficiency Database (HEED)

- Central Feed-in Tariff Register2 (supplied by Ofgem)

- Green Deal

- ECO data (supplied by Ofgem and held by BEIS)

- Experian household characteristics

In addition to these main data sources feeding into the framework at a property level there are a number of other indicators that have been assigned to the property based on its geographic location. For example, an index of multiple deprivation and a fuel poverty

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[2] Further information on the Central Feed-in Tariff register can be found via this webpage:
https://www.gov.uk/government/statistical-data-sets/monthly-central-feed-in-tariff-register-statistics

indicator are assigned based on the Lower Layer Super Output Area (LSOA). There are approximately 40,000 LSOAs in England, Scotland and Wales, with each one representing a population of roughly 1,500 individuals or 600 households.

NEED has supported a number of BEIS policies. It has been used to understand the reduction in consumption for households installing energy efficiency measures. To date NEED has looked at savings from a number of measures, including cavity wall insulation, loft insulation, installation of condensing boilers and solid wall insulation. The estimates from NEED were used to inform "in use factors" for the Green Deal. Data on consumption has informed Fuel Poverty analysis so there is a better understanding of actual consumption for different types of properties and households and therefore a better understanding of how policy options will impact on different households.

BEIS would like to thank all those who made this analysis possible, including: Energy Suppliers, Ofgem, Gas Safe, the Energy Savings Trust and the Valuation Office Agency.

All analysis of domestic properties presented in this report is based on a representative sample of properties in England & Wales, stratified by local authority, number of bedrooms, property type and property age.

The rest of this report covers:

- Domestic Energy Consumption: analysis of domestic gas and electricity consumption by property attributes, household characteristics, geography and socio-demographic classifications

- Impact of Energy Efficiency Measures in Homes: analysis of the impact of installing energy efficiency measures on a household's gas consumption

3. Domestic energy consumption

This section presents analysis of domestic gas and electricity consumption by property attributes, household characteristics, geography and socio-demographic classifications.

Results are based on a representative sample of approximately four million properties for England & Wales, with the exception of trends in consumption which covers only England between 2005 and 2010 and both England & Wales for 2011 to 2016[3]. A sample is used rather than the complete dataset to increase processing speed, reduce cost and to ensure that BEIS is not processing more data than necessary.

Analysis of consumption trends in Scotland is included as a sub-section at the end of this chapter. Unlike England & Wales, the analysis is carried out on all properties in Scotland since this is a smaller dataset and requires less processing time. The sub-section on Scotland consumption will go into further detail on the other differences compared to England & Wales.

All consumption figures presented in this section are based on valid domestic gas and electricity consumption[4] and are rounded to the nearest 100 kWh. All gas consumption data are presented on a weather corrected basis[5]. Gas is predominantly a heating fuel, meaning that its use depends heavily on the weather. Therefore consumption for each household has been adjusted to account for differences in temperature and wind speed in each year. This allows for a more consistent comparison of gas consumption over time[6]. Electricity is used for a much wider variety of reasons (and far less often as a heating fuel) meaning consumption is less affected by the weather, so this data is not temperature corrected

Owing to a methodological change in how gas meter readings are reported the current sample only includes households where we have a confirmed reading and does not include any readings that are the same as the previous year. This means that the number of households used in the gas consumption sample is approximately 20 per cent smaller than previous years. The change in methodology means the reported gas period has changed, more details of which can be found in the Executive Summary. Users of this data should be aware that there is an average 6-month difference in the reporting period when comparing the latest electric and gas consumption data (2016 electricity represents

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[3] Results for 2005 to 2016 presented in this report can be considered as a continuous trend. Refer to the methodology note for further detail: https://www.gov.uk/government/publications/domestic-national-energy-efficiency-data-framework-need-methodology
[4] Valid domestic gas consumption readings are taken to be values between 100 kWh and 50,000 kWh (inclusive). Domestic electricity consumption is considered valid if it is between 100 kWh and 25,000 kWh (inclusive). Gas and electricity consumption values which have been carried over from the previous year have been excluded.
[5] More information about the weather correction methodology can be found here: https://www.gov.uk/government/publications/overview-of-weather-correction-of-gas-industry-consumption-data
[6] Users should note that the weather correction factor applied to the consumption data is modelled and as such may not entirely remove the effects of extreme weather in a single year.

consumption from the 2016 calendar year and the 2016 gas period represents consumption from July 2016 – July 2017).

The relationship between energy use and any individual characteristic is complex, but there is a high correlation between certain characteristics and a household's energy use (for example, size of property or household income). This section provides insight into how each characteristic relates to energy use but makes no attempt to control for other characteristics[7]. The results presented here are broadly consistent with results for earlier years presented in previous reports, overall there has been a small reduction in electric consumption and a small increase in gas consumption. This may reflect an increase in the number of properties using gas as the main fuel for heating rather that electricity, liquid or solid fuels.

3.1 Headline domestic consumption

In 2016 the median[8] gas consumption for all properties in the sample was 12,300 kWh, with median electricity consumption at 3,200 kWh. However, within the distribution there is a range of consumption as can be seen from the lower and upper quartiles[9] shown in Table 3.1. The table also shows that mean consumption is larger than median consumption, by 9 per cent for gas and 22 per cent for electricity. In the rest of this section, median consumption has been used to represent typical consumption. It is a more appropriate measure of typical consumption than the mean because the mean can be influenced by a relatively small number of high consuming households that are not typical of the rest of the population.

It is worth noting that the properties used to calculate consumption figures were filtered to only include gas consumption between 100 – 50,000kWh. Electric consumption was filtered to only include values between 100 – 25,000kWh.

Table 3.1 also shows that there is more variation in electricity consumption than gas consumption. The standard deviation[10] is 55 per cent of the mean for gas and 74 per cent for electricity. The larger variability (or spread of data) for electricity is likely to be due to the wider range of uses of electricity, including the variation between households that use electricity as the main heating fuel and those that do not, as well as the use of electricity for secondary heating.

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[7] See Annex C in NEED 2016 where principal component analysis was used to investigate the main drivers of gas demand, with determining factors considered simultaneously: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2016

[8] The median is the middle value of the distribution, i.e. the consumption value where half of the households have lower consumption and half have a higher one.

[9] Quartiles (including the median) divide the consumption values into four parts containing the same number of households. The lower quartile is the consumption value where 25 per cent of households have lower consumption and 75 per cent have higher. The upper quartile is the consumption value where 25 per cent of households have higher consumption and 75 per cent have lower.

[10] The standard deviation is a number which measures the spread of a group of values from the average (mean).

The distribution of gas and electricity consumption in 2016 is shown in more detail in Figure 3.1. It shows that generally most households consume around 12,300 kWh of gas and 3,200kWh of electricity. Fewer households consume higher volumes of gas or electricity, which is indicated by the longer right tail of the distribution.

Table 3.1: Annual consumption summary statistics, 2016

					(kWh)
	Mean	Standard Deviation	Lower quartile	Median	Upper quartile
Gas	13,400	7,400	8,400	12,300	17,100
Electric	3,900	2,900	2,000	3,200	4,800

Figure 3.1: Distribution of consumption, 2016

Gas Consumption 2016 (kWh)
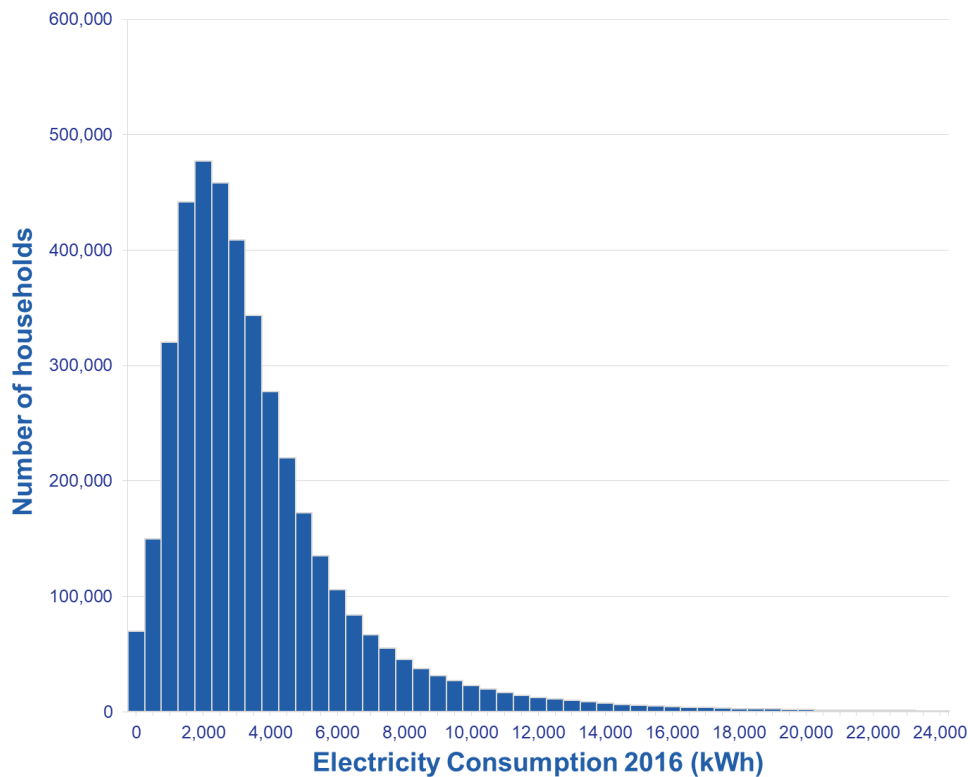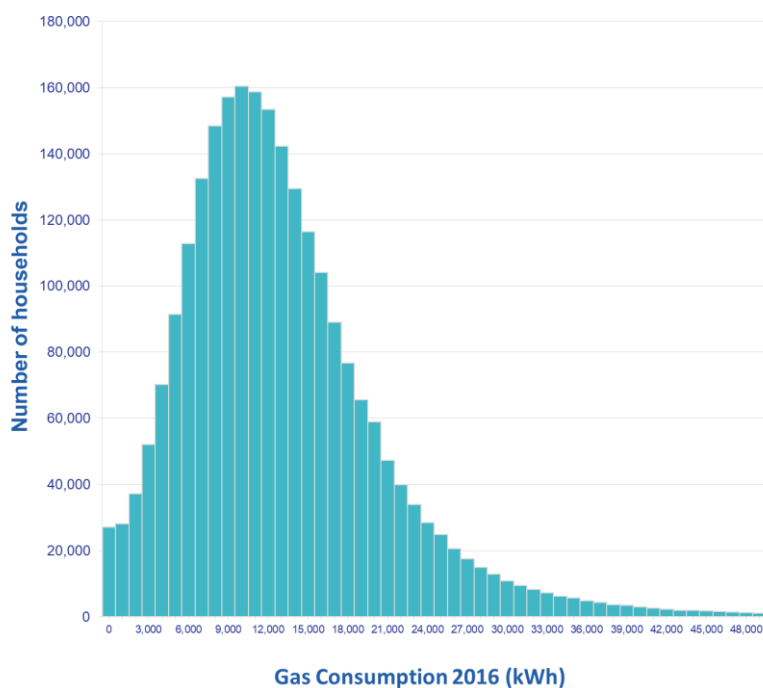
3.2 Domestic consumption breakdowns

This section presents domestic gas and electricity consumption by property attributes, household characteristics and socio-demographic classifications. Annex B shows details of all consumption tables available from NEED. For all variables, the numbers of households in the sample along with mean and median figures for consumption are included in the headline tables published alongside this report. Additional statistics to describe the pattern of consumption such as standard deviation and quartiles are included in the additional tables published alongside this report.

In line with previous years, domestic electricity and gas consumption have been published by index of multiple deprivation quintile, rural urban classification and fuel poverty quintile. Fuel poverty quintile is a classification generated by ordering all LSOAs in England and Wales by the percentage of homes estimated to be fuel poor within each LSOA. The ranked LSOAs are then grouped into quintiles. A household's fuel poverty quintile is set as the quintile of its LSOA, so all properties within an LSOA will have the same classification. The percentage of properties considered to be fuel poor is published by the Fuel Poverty Statistics team[11]. These data are available for annual electricity and gas consumption between 2011 and 2016.

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[11] Published estimates of the percentage of households which are fuel poor are published by the BEIS Fuel Poverty Statistics Team. The LSOA level data ca be found on the following link: https://www.gov.uk/government/statistics/sub-regional-fuel-poverty-data-2017

Figure 3.2 shows typical electricity and gas consumption for households in 2016 by property type. It can be observed that flats consume the least amount of electricity and gas. Purpose-built flats consumed 24 per cent less gas in 2016 than converted flats, with typical consumptions of 6,800 kWh and 8,900 kWh respectively. This could be a result of the high proportion of purpose-built flats constructed for social housing, which are known to be more energy efficient[12] and therefore consume smaller quantities of gas.

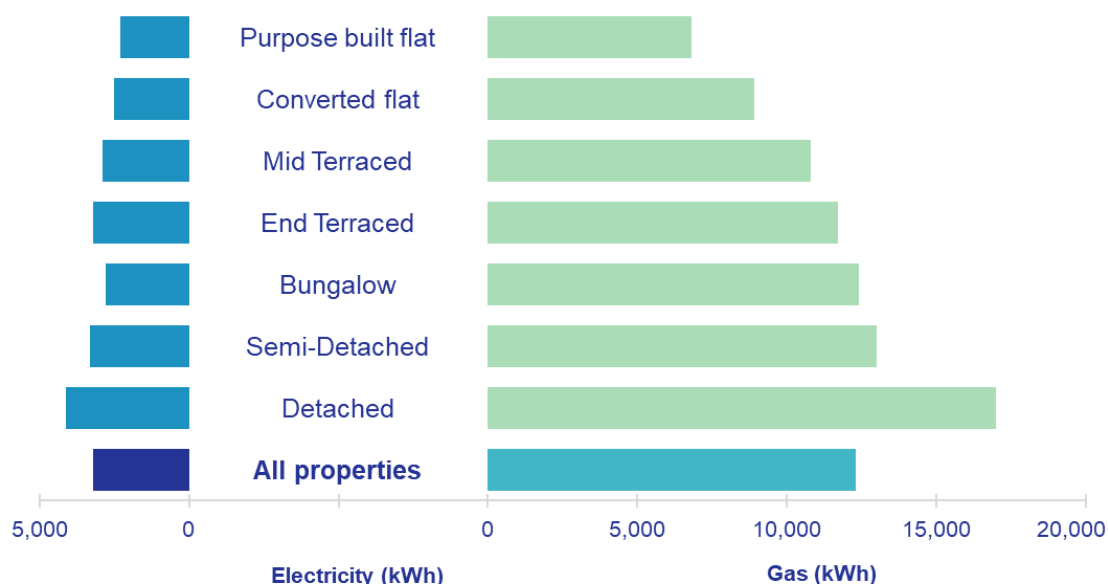**Figure 3.2: Median consumption (kWh) by property type, 2016**

Figure 3.2 also shows that detached houses typically consume more electricity and gas than any other property type. In 2016, a detached house typically consumed 4,100 kWh of electricity and 17,000 kWh of gas, which equates to a consumption difference of two and half times as much gas and 78 per cent more electricity than a purpose-built flat. The large difference in gas consumption can be partly explained by the use of gas as a heating fuel and the isolation of a property. As a detached house is not attached to another property, a higher proportion of heat is likely to be lost through the walls, whereas a flat is surrounded by other flats that also generate heat, which means it is a more efficient property type for keeping the occupants warm. It is also important to note that detached houses are typically the largest property type and therefore will require more gas to heat than a smaller property.

Bungalows usually consume more gas than their typical electricity consumption would suggest. Figure 3.2 shows that although a bungalow generally consumed less electricity than a mid-terraced property in 2016, typical consumption of gas exceeded that of a mid-

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[12] The energy efficiency of the housing stock has improved between 2005 and 2016 for all households. Figure 2.9 of the English Housing Survey headline report 2016-17 shows that in particular properties owned by a housing association have a higher Standard Assessment Procedure (SAP) rating. The report can be found on the following link:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/705821/2016-17_EHS_Headline_Report.pdf

terraced property and an end-terraced property. This is partly due to a higher number of exposed walls, therefore less insulation and higher gas consumption to heat the property. The higher prevalence of older people living in bungalows also has an impact.

Figure 3.3 shows median gas and electric consumption for each fuel poverty quintile. The data shows that households that are more fuel poor consume on average less gas compared with households that are the less fuel poor. The data also shows that the difference in consumption between fuel poverty quintiles is less than that for other classifications such as income or floor area.

Figure 3.3: Median consumption (kWh) by fuel poverty quintiles, 2016
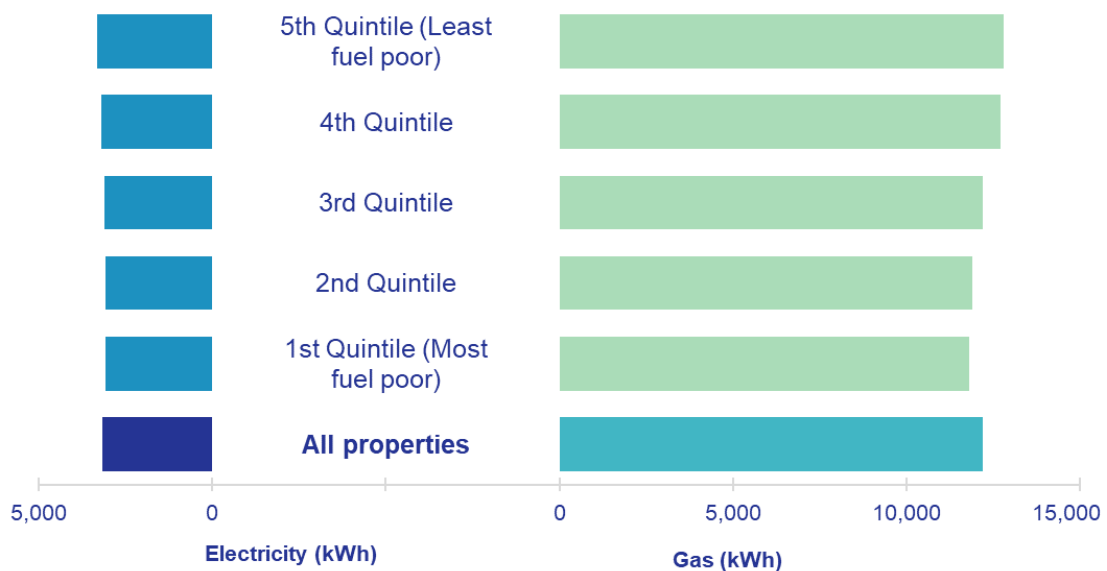

Figure 3.4 shows typical gas consumption by property size and the number of adult occupiers. As can be seen from the chart, floor area is an important determinant of gas demand, with the largest floor area category (over 200 m^2), consuming over four times as much gas as the smallest category (50 m^2 or less) with one adult occupying the property. The relationship between floor area and gas consumption is roughly linear, with consumption per square meter remaining broadly consistent across the floor area categories.

Figure 3.4 also shows the effect of the number of household occupants on gas consumption, within each property size band. As the chart shows, the amount of gas used increases for every additional adult that lives in the property. This could reflect the fact that as the number of occupants increases, the proportion of time that a home is occupied by at least one person increases, and so the proportion of time that the property is heated is likely to increase. It is also likely that as the number of occupants increases, the proportion of a property that is heated increases.

Figure 3.4: Median gas consumption (kWh) by floor area and number of adults, 2016
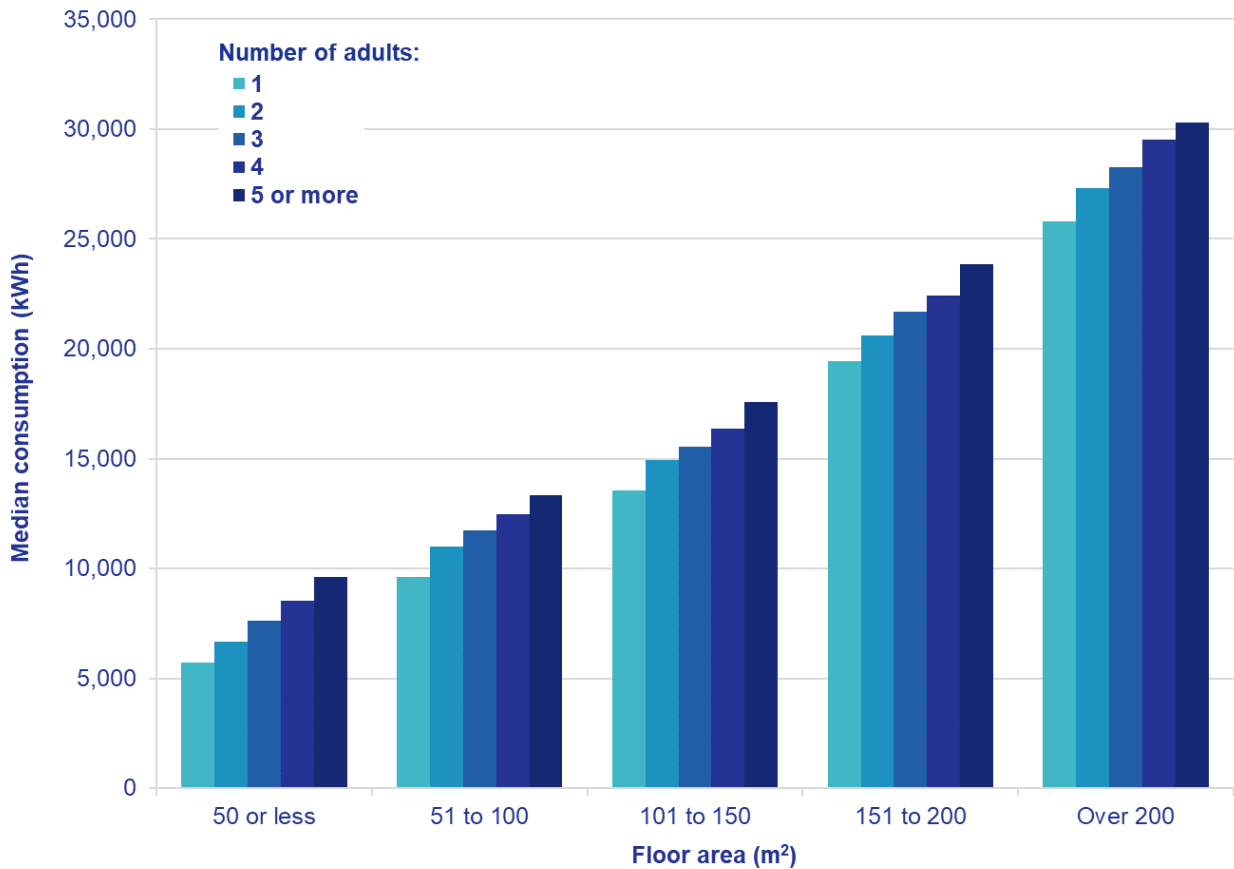
Figure 3.4 was created using data from the NEED table creator tool using rounded data. This tool is designed to provide users with the ability to create bespoke cross tabulations on electricity and gas consumption by property attributes and household characteristics. Two variables can be selected (e.g. Index of Multiple Deprivation quintile and number of bedrooms) and the table will show the number of observations, mean and median consumption. There is also a choice of fuel (electricity or gas). Where available, data for each year from 2005 to 2016 are included. The data used in the creation of the tables can also be downloaded as a comma separated values (.csv) file for ease of reuse. The tool and data files can be found at the following location:
https://www.gov.uk/government/statistical-data-sets/need-table-creator.

3.3 Trends in domestic consumption

This section provides analysis of the trends in median gas and electricity consumption between 2005 and 2016 for different property attributes and household characteristics. Figure 3.5 shows the median gas and electricity consumption for all households in the NEED sample with valid consumption in each year from 2005 to 2016. Data for 2005 to 2010 cover England only and later data (2011 onwards) cover both England & Wales.

Figure 3.5 shows that median consumption for both gas and electricity has been steadily declining over the since 2005. Although median gas consumption has fallen by 30 per cent between 2005 and 2016, there was an increase of 2 per cent in 2016 compared to 2015. Between Q3 2016 and Q3 2017, approximately representative of the 2016 gas period, gas prices fell by 1.8 per cent[13]. This small decrease in the price of domestic gas may have partly contributed to the small increase in gas consumption observed during the period[14]. Median electricity consumption decreased by 16 per cent between 2005 and 2016. Between 2015 and 2016 median electricity consumption fell by a further 3 per cent.
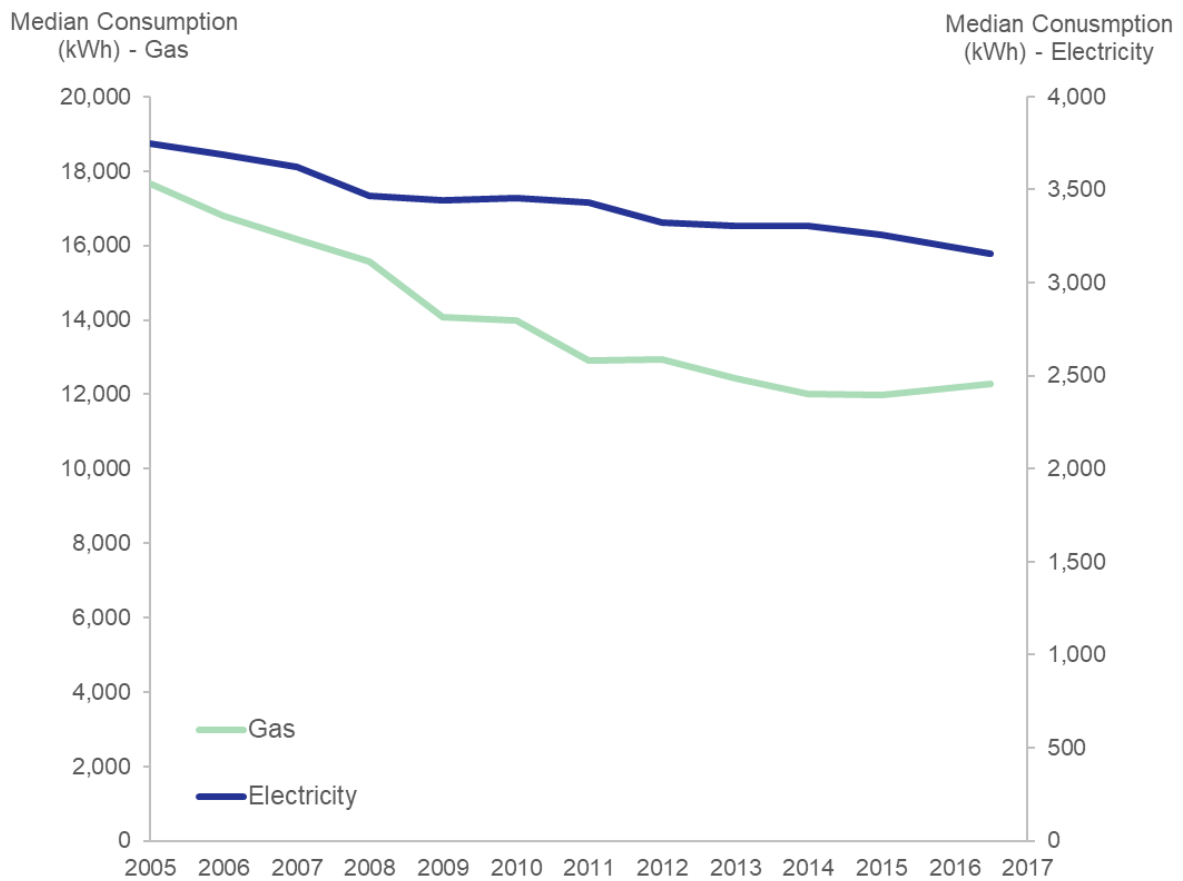
Analysis presented in a previous NEED publication[14] indicates that increases in gas prices have made a notable contribution to the overall decline in domestic gas consumption seen over the last decade. Evidence within the referenced analysis also suggests that lower income households are more sensitive to price rises, causing them to reduce consumption to a greater extent in response to a rise in price compared to higher income households. As lower income households are more likely to live in smaller properties, this might explain why gas consumption has fallen faster in these categories. Meanwhile, electricity prices have not risen to the same extent as gas prices in recent years, which perhaps explains why median gas consumption has increased and electricity decreased, as shown in Figure 3.5. There are, however, additional factors which may also have influenced the observed pattern. For instance, a far higher proportion of small properties (particularly high-rise flats) use electricity for heating, compared to larger properties that predominantly use gas.

The long-term trend of reduction in consumption over time could be a result of a number of factors. These potentially include: energy efficiency improvements in households[12] such as: new boilers, insulation and more efficient appliances; higher prices[14] and the 2008 recession; or changes in the building stock and household composition.

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[13] Quarterly Energy Prices – December 2017. https://www.gov.uk/government/statistics/quarterly-energy-prices-december-2017
[14] See Annex D in the NEED 2016 publication for a discussion of the evidence of how gas price changes affect consumption levels: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2016

Figure 3.5: Median gas and electricity consumption (kWh), 2005 to 2016

The fall in median consumption is seen consistently across all property types, household characteristics, geographies and socio-demographic classifications. However, certain households will have been affected to a greater or lesser extent by the different factors described above. The remainder of this section provides some highlights of changes over time for different property attributes and household characteristics. All changes in consumption are shown as an index relative to a 2005 baseline.

3.4 Trends in domestic consumption by property attributes

Figure 3.6 shows the trend in median gas consumption by property type. It demonstrates that between 2005 and 2016 the fall seen in overall consumption was evident among all property types. However, in general, smaller properties showed a greater percentage decrease in median consumption when compared with larger properties. For example, in 2016 typical gas consumption for flats was 33 per cent lower than in 2005, but for detached dwellings this reduction was only 27 per cent. The mid-size property types (bungalows, semi-detached and terraced) followed an almost identical pattern to each other. Despite the general increase in gas consumption in 2016, detached houses saw a small 100 kWh decrease in median gas consumption, whilst bungalows remained at the 2015 consumption level.

Figure 3.6: Percentage change in median gas consumption over time by property type (2005=100)
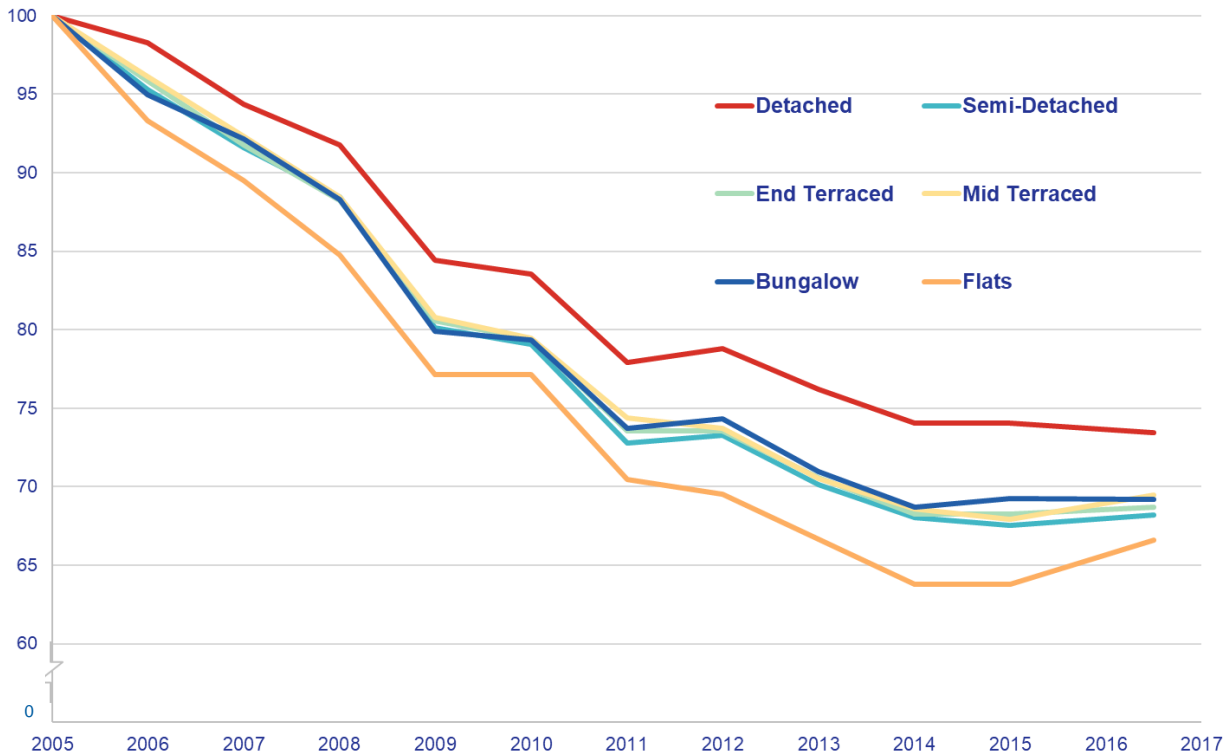
Figure 3.7 shows that detached properties saw the largest decline in median electricity consumption between 2005 and 2016 (19 per cent) while flats (13 per cent) and bungalows (14 per cent) saw the smallest. This contrasts with changes in gas consumption where flats saw the greatest percentage decrease.

The higher volatility in Figure 3.7 compared to Figure 3.6 likely reflects the fact that, unlike gas, the electricity consumption figures are not weather corrected. It is estimated that 14 per cent of properties are off the gas grid and use alternative fuel sources, including electricity to heat their homes[15].

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[15] Estimates of households not connected to the gas network: https://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network

Figure 3.7: Percentage change in median electricity consumption over time by property type (2005=100)
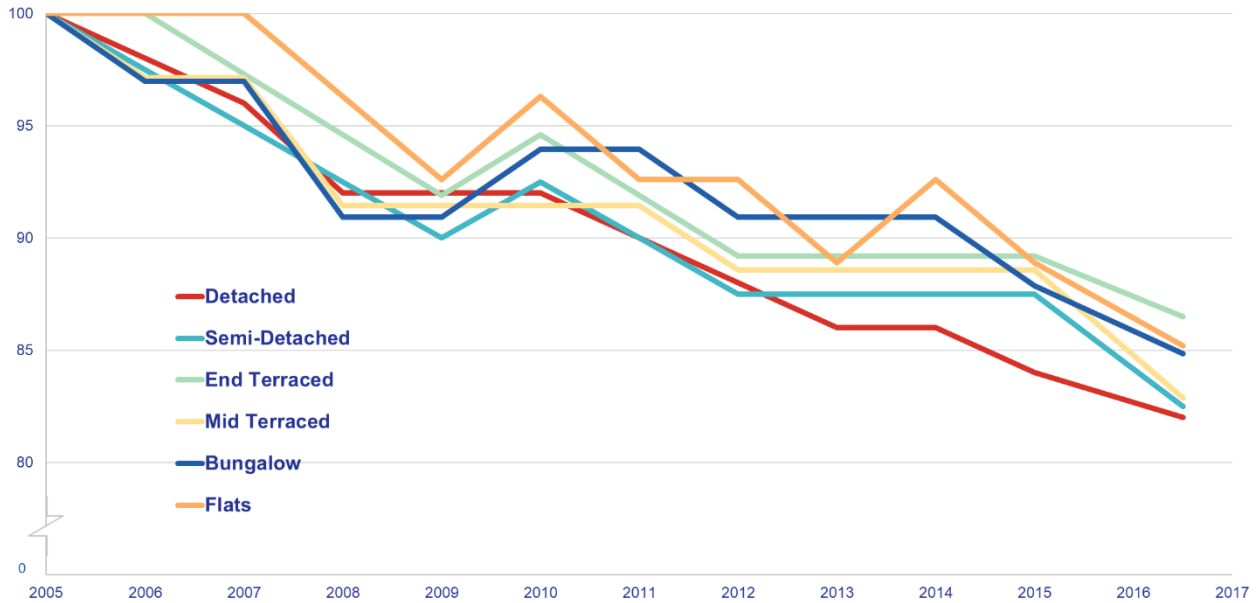
3.5 Trends in domestic consumption by household characteristics

Figure 3.8 shows the trend in consumption of gas since 2005 split by tenure. Over this time council housing and housing association properties have consistently exhibited a faster decline in consumption when compared to owner-occupied properties.

Figure 3.8 Percentage change in median gas consumption over time by tenure (2005=100)

3.6 Scottish consumption

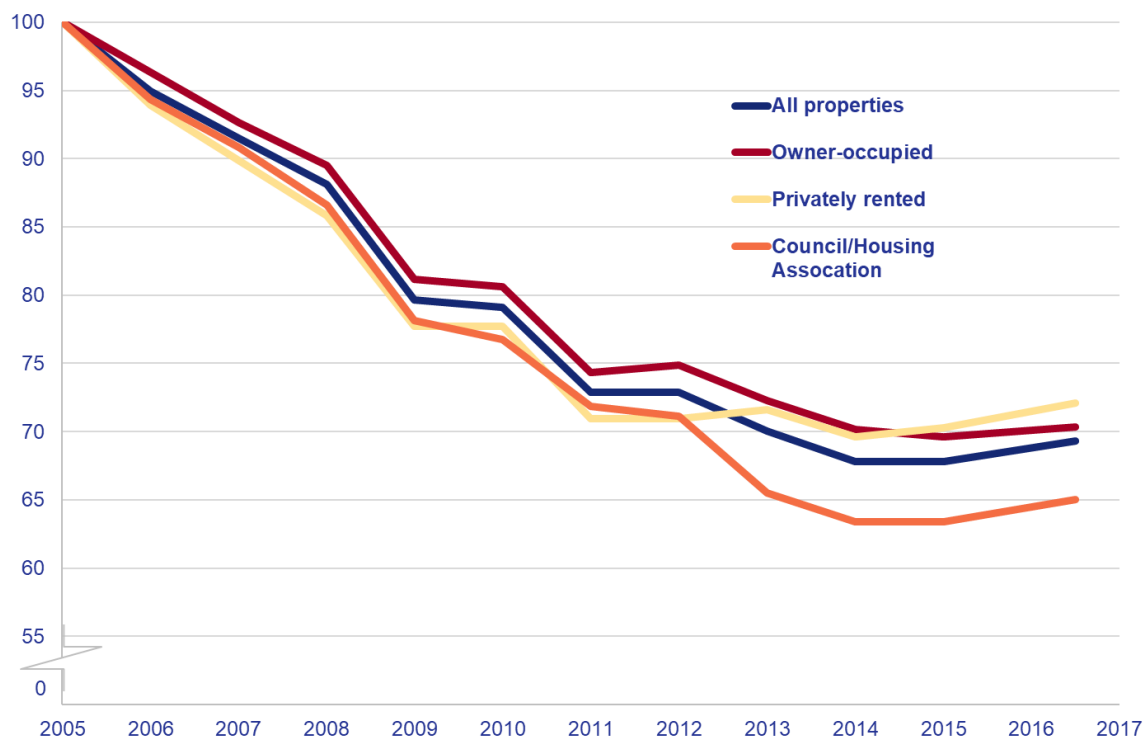Unlike England & Wales, this analysis was carried out on all properties in Scotland since this is a smaller dataset and requires less processing time. The other difference is that modelled data from Experian have been used for most property attributes and household characteristics in this analysis. This is with the exception of property type and floor area, where data from the Scottish Assessor have been used (the organisation responsible for valuing properties in Scotland, which hold data on property characteristics in Scotland). In the case of property type the Scottish Assessor Data has been complemented with Experian data owing to the Scottish Assessor data not recording the distinction between houses and bungalows (e.g., where Experian data categorises a property as a bungalow we have used this data to replace the Scottish Assessor record). Comparisons between the Experian and Scottish Assessor data shows that for all other property types the data sets are broadly in line where like for like categories are used. For example, the agreement between the Scottish Assessor data and Experian when classifying a property type as a flat is 78 per cent.

The use of Experian's modelled data for property attributes in Scotland allows analysis to be undertaken. However, it also increases uncertainty in the estimates. Therefore these

results should be treated as provisional and interpreted with caution. To help reduce uncertainty, the results for Scotland are based on all properties in Scotland that could be matched to valid consumption data, unlike England & Wales where a sample of properties is used for analysis[16].

This section outlines the domestic gas and electricity consumption statistics for 2016 (and 2011 to 2015 in the accompanying tables) by property attributes and household characteristics.

In 2016, the median gas consumption for properties in Scotland was 12,600 kWh with median electricity consumption at 3,300 kWh. The equivalent figures for England & Wales are 12,300 kWh and 3,200 kWh respectively, showing that typical consumption in Scotland is higher than in England & Wales (2 per cent higher for gas and 3 per cent higher for electricity).

Table 3.2: Annual consumption summary statistics, Scotland 2016

	Mean	Standard deviation	Lower quartile	Median	Upper Quartile (kWh)
Gas	14,000	8,100	8,400	12,600	18,000
Electricity	4,100	3,200	2,100	3,300	4,900

As with England & Wales, there is more variation in electricity consumption than gas consumption. This is because gas is primarily used for heating and cooking, while electricity can be used for a range of purposes.

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[16] Match rates for England, Wales and Scotland combined are shown in Methodology guidance note.

3.6.1 Trends in domestic consumption by property attributes

Properties with more bedrooms typically consume a larger amount of gas and electricity than properties with fewer bedrooms since there is more space to heat (Figure 3.9). Properties with five or more bedrooms typically consumed 23,100 kWh of gas and 4,700 kWh of electricity. The equivalent figures for properties with one bedroom are 7,900 kWh of gas and 2,300 kWh of electricity. When looking at typical consumption for properties in England & Wales by number of bedrooms the same pattern is seen, i.e. properties with more bedrooms typically consume more gas and electricity.

Figure 3.9: Median consumption (kWh) by number of bedrooms, Scotland 2016

The number of bedrooms can also act as an indicator of property size, as there is a strong correlation between the number of bedrooms in a property and the floor area of the property.

Detached properties have the largest typical consumption for both gas and electricity. Bungalows have the second highest median consumption for gas at 14,600 kWh - a finding which is not consistent with England & Wales where instead semi-detached properties typically consume the second highest amount of gas (Figure 3.10). This is because Scotland has proportionally larger sized bungalows (based on number of bedrooms) compared to England & Wales. In contrast to last year, Semi-detached and terrace properties had the second and third highest median consumption at 3,400kWh and 3,200kWh respectively, for electricity in Scotland whereas Bungalow's consumed the fourth highest at 3,000kWh.

Figure 3.10: Median consumption (kWh) by property type, Scotland 2016

## 3.6.2 Trends in domestic consumption by property attributes

The household characteristics of household income, tenure and number of adult occupants for Scotland are based on the same source as data for England & Wales (Experian). This allows direct comparisons between typical consumption results from Scotland with those from England & Wales. Scottish households typically consume more gas than households in England & Wales, with this difference generally becoming wider as income increases (Figure 3.11).

Typical gas consumption of households with an income less than £15,000 in Scotland in 2016 was slightly higher at 10,300 kWh compared with 10,200 kWh in England & Wales (a difference of 1 per cent). For households with an income over £150,000, typical gas consumption in Scotland was 24,900 kWh compared with 21,100 kWh in England & Wales (a difference of 15 per cent)[17]. Fifty-eight per cent of households with an income of over £150,000 lived in detached properties who typically consumed the most gas (29,900 kWh) compared to other property types in this income band.

Despite this, gas consumption exhibited a very similar pattern when comparing Scotland with England & Wales, with typical gas consumption generally increasing as household income increased. On average, electricity consumption for each income band follows a very similar pattern to gas.

[17] Only 0.6 per cent of all properties in Scotland had household income of £150,000 or more compared to 1.2 per cent of properties in England & Wales.

Figure 3.11: Median domestic gas consumption (kWh) by household income, 2016
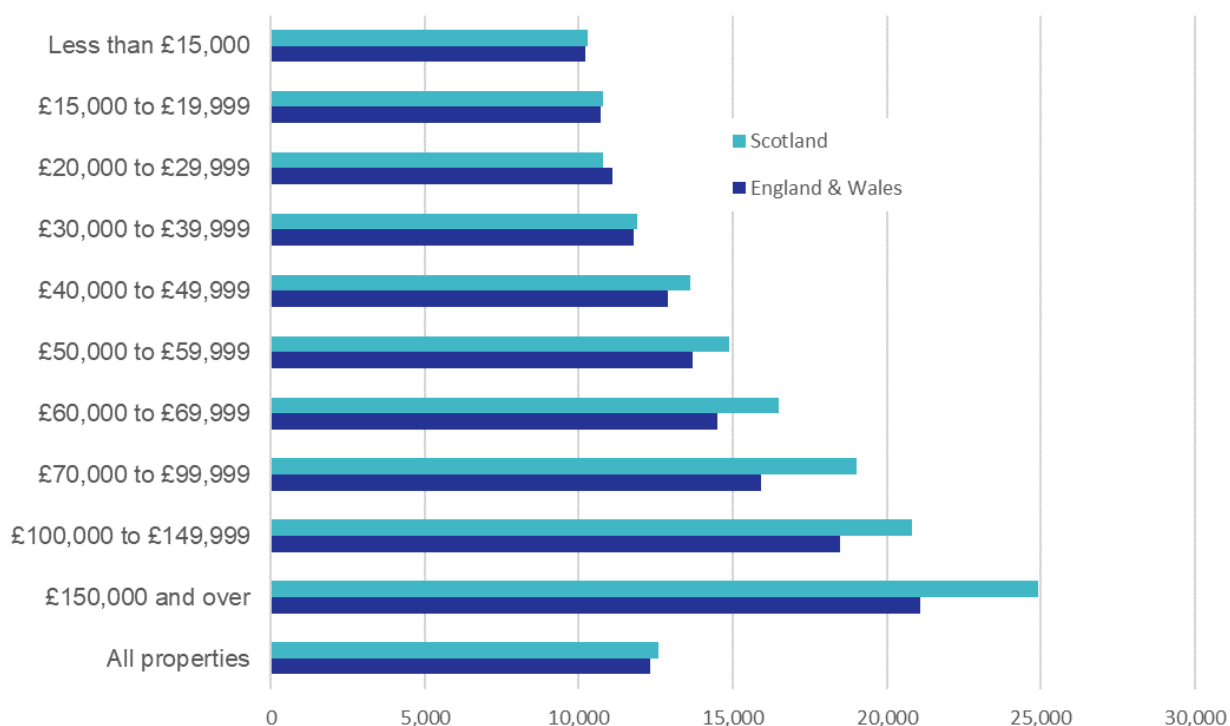
For both Scotland and England & Wales, owner-occupiers were the highest typical consumers for gas compared to the other tenure groups (14,400 kWh in Scotland and 13,400 kWh in England & Wales) (Figure 3.12). This is because 67 per cent of owner-occupied properties in Scotland and 73 per cent in England & Wales were larger in size (3 or more bedrooms) compared to privately rented properties and council housing, which generally consists of smaller properties (1 or 2 bedrooms).

Households typically consuming lower levels of gas were in different tenure categories when comparing Scotland with England & Wales. In Scotland the lowest consuming tenure type was privately rented at 8,800 kWh; in England and Wales it was council housing at 9,200 kWh. This difference can largely be explained by on average there being more larger council rented properties compared with privately rented properties in Scotland. In Scotland 34 per cent of council rented properties have 3 or more bedrooms compared to 22 per cent in the private rented sector. The opposite is observed in England & Wales where privately rented properties are generally larger than council rented properties. In England & Wales only 5.7 per cent of properties rented from the council have 3 or more bedrooms compared to 31 per cent in the private rented sector.

Figure 3.12: Median domestic gas consumption (kWh) by tenure, 2016
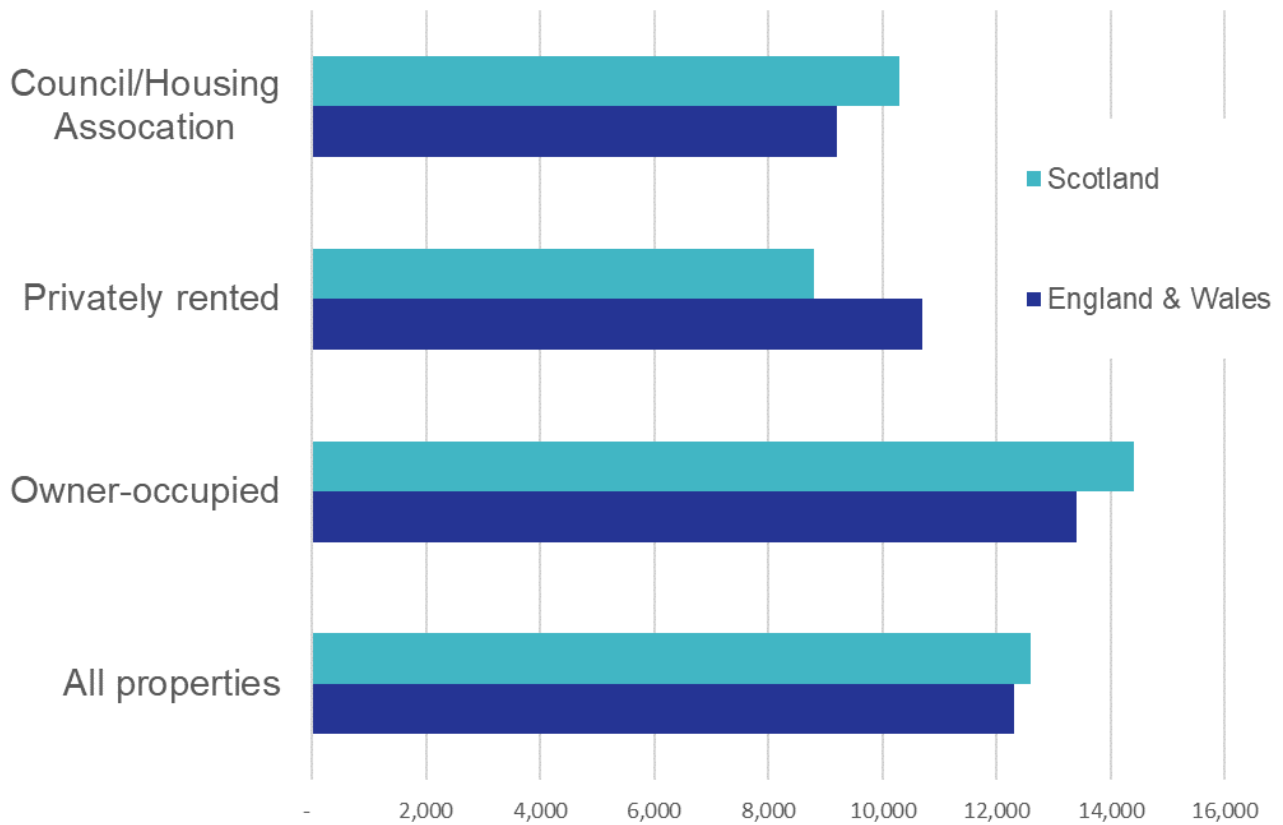
Following a similar pattern to gas consumption, owner occupiers also consumed more electricity compared to the other tenure groups. Scottish owner-occupiers typically consumed 3,500 kWh, 200 kWh more than England & Wales (3,300 kWh). Council households in Scotland and England & Wales generally consume the least amount of electricity, with levels of consumption similar in all countries (2,800 kWh). Across the tenure groups, in both Scotland and England & Wales, flats typically consumed the least amount of electricity, of which council flats consumed less than privately rented and owner-occupied properties.

Council flats consumed more electricity compared to privately rented flats in Scotland. This is likely to be due to the relative size of council flats compared to privately rented flats. In Scotland there are more than twice as many three bedroom council flats compared to those rented privately.

Figure 3.13: Median domestic gas consumption (kWh) by number of adults in a household, 2016
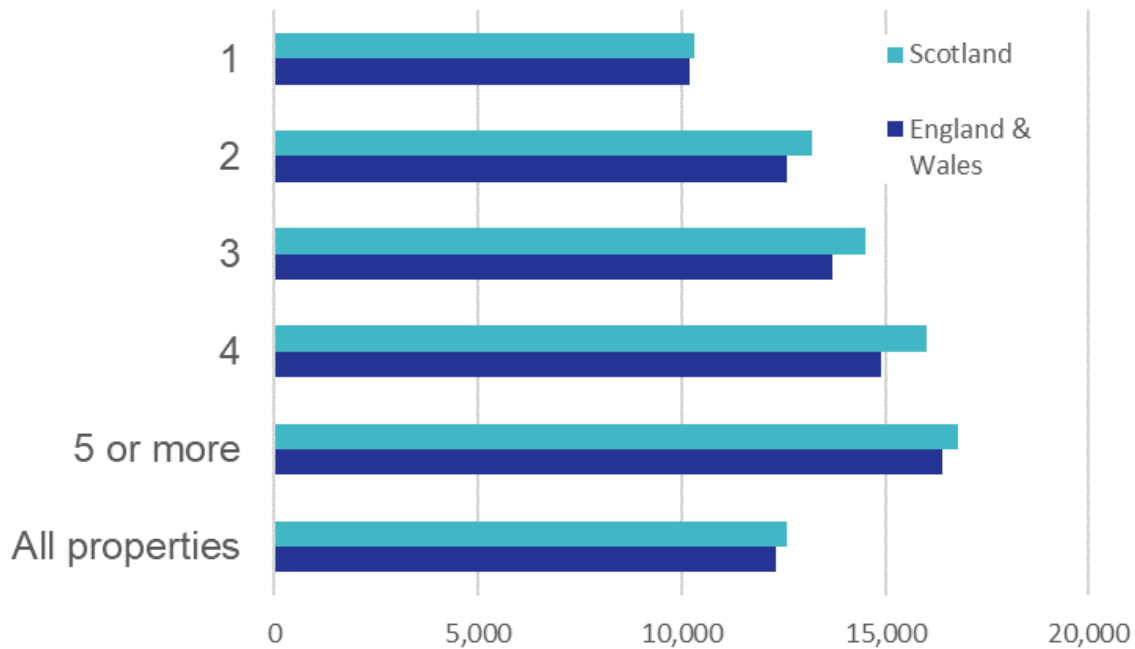
Scottish households typically consumed marginally more gas than households in England & Wales, with this difference generally getting larger as the number of occupants increased (Figure 3.13). Typical gas consumption of households with one adult occupant in Scotland was 10,300 kWh compared with 10,200 kWh in England & Wales. For households with five or more adult occupants typical consumption in Scotland was 16,800 kWh compared with 16,400 kWh in England & Wales. A similar pattern was observed for electricity consumption.

4. Impact of energy efficiency measures in homes

4.1 Background to the analysis

This chapter analyses the impact of installing energy efficiency measures on gas consumption for households in England, Wales and Scotland[18][19]. Headline tables summarising the results for the 2018 publication are published alongside this document. The energy efficiency measures included in this analysis are:

- Cavity wall insulation

- Loft insulation

- Boiler

- Solid wall insulation

The impact of installing a combination of these measures has also been explored in section 4.3 of this chapter.

Analysis has also been conducted on the effect which installing solar photovoltaic (solar PV) panels has on mains **electricity** consumption (see Section 4.2).

The measures used in this analysis are recorded by BEIS through government schemes. It is important to understand how the energy efficiency measures impact on a household's energy use, both to help understand the impact of past policy and help with the effective design of new policies.

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[18] Impact of measures analysis for Scotland is completed separately to England and Wales, and is detailed later in this chapter.
[19] The impact of measures analysis is presented for measures installed between 1st October 2014 and 30th September 2015 (2015 gas period), as the saving is calculated by looking at the difference between 2016 and 2014 gas and electricity consumption.

Policy Context

The Energy Company Obligation (ECO) and Green Deal (GD) are Government energy efficiency schemes which began operating in 2013[20]. They replaced the previous schemes: Carbon Emissions Reduction Target, Community Energy Saving Programme and Warm Front. Their aim is to encourage the uptake of energy efficiency measures so that the efficiency of the building stock is improved. This has impacts such as reduced consumer bills and increased comfort in the home.

Results presented in this section refer to the savings in household gas consumption. All gas consumption data are presented on a weather corrected[21] basis – which means the consumption for each household has been adjusted to account for differences in temperature and wind each year. The estimated savings are observed savings in real homes. They may therefore be affected by 'comfort taking'[22] and do not take into account the quality or coverage of the energy efficiency measure installed. For example, estimates could include some properties which have only had cavity wall insulation installed in three of their four walls. Individual households therefore have the potential to make a greater saving than the headline results presented in this report. There is also potential for households to make smaller savings than those presented here, since there are a number of factors that can impact the amount of gas a household consumes, such as the number of people, or how long the house is vacant for.

The analysis compares the gas consumption in properties before and after an energy efficiency measure was installed, with the change in consumption over the same period for similar properties which have not had any measure installed. To do this, an intervention and comparator group are created. The intervention group contains properties which have received the energy efficiency measure being considered (and no other measure as

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[20] For more detail on ECO and GD see Annex A (page 34) of the household energy efficiency annual report: https://www.gov.uk/government/statistics/household-energy-efficiency-national-statistics-detailed-report-2017

[21] An overview of the weather correction of gas industry consumption data was published in Annex E of the 2016 NEED statistics: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2016l

[22] Comfort taking is where some households take the benefit of the insulation measure through increased warmth rather than entirely through energy saving. For example, a household may have had their thermostat set lower than they wanted in order to lower their gas use, but after installing an energy efficiency measure they could choose to increase the temperature on their thermostat and use the same amount of energy since their property should now retain the heat better than before due to the improved energy efficiency.

recorded by BEIS). The comparator group contains properties with similar characteristics that have not had an energy efficiency measure installed at any point.

Year-on-year the sample of eligible intervention and comparison homes gets smaller as more homes are having measures installed. Additionally, with changes in government schemes and increases in the number of different measures which could be installed, the number of homes with one measure only is reducing – making it more challenging to isolate the effect of installing one measure. In 2018 this has been the case for all combination measure groups and most single measure analysis, except for condensing boilers which continue to have many installations recorded. For the combination groups of multiple measures the sample size was too low to provide a robust breakdown of saving estimates by property and household characteristics. Therefore, these results have not been published in 2018.

Results cover the installation of energy efficiency measures over the period 2005 to 2015. Therefore, ECO and GD measures installed after 30 September 2015 are not presented in the current publication. The effect of more recent measures funded through ECO and GD will be explored in future publications.

Not all households are included in the analysis:

- Flats, due to insufficient address information when matching meter readings, are excluded to avoid matching flats to wrong meter point readings which would produce inaccurate estimates

- In previous publications, properties built post-1999 have been excluded from cavity wall and loft insulation analysis due to a change in building regulations[23] and the requirement for all newly built properties to have loft and cavity wall insulation as standard as of that date. However, key revisions were made to building regulations regarding cavity walls between 1985 and 2001, with the requirements for wall U-value changing each time. Due to these iterative changes in building regulations, the flexibility in the regulations and the number of allowable technical solutions, there is uncertainty regarding the extent to which these cavities were insulated, their method of construction, and their baseline U-values. As a result, in the 2018 publication, all properties that have received cavity wall insulation were used in the analysis

- Properties with unusually large fluctuations in consumption, or identical year-on-year figures of gas or electricity consumption, have been excluded also.

All headline figures in this report are weighted - savings have been adjusted to be representative of the complete housing stock (excluding flats) rather than just the properties which have had the measure installed in the year under consideration.

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[23] Further information about building regulations can be found in Annex C of this publication.

The estimates set out in the rest of this chapter provide insight into the range of savings experienced and how savings vary for different types of properties and households. A negative figure indicates the observed saving in consumption for the intervention group following the installation of an energy efficiency measure, compared to the comparator group.

Further details about the how the impact of measures analysis is put together, can be found in the NEED methodology note: https://www.gov.uk/government/publications/domestic-national-energy-efficiency-data-framework-need-methodology

4.2 Impact of installing a single energy efficiency measure

This section presents headline results and key findings for the impact of installing a single energy efficiency measure in homes in the 2015 gas period (between 1st October 2014 and 30th September 2015). Table 4.1 below shows the average savings experienced in gas consumption for properties having the following installations in 2015. For all energy efficiency measures the median saving is higher than the mean, indicating there is a skewed distribution in the change in consumption. The includes outlier properties where the gas consumption actually increased after the installation of a measure.

Table 4.1: Summary of changes in consumption (weighted) – single energy efficiency measure installed in the 2015 gas period[1,2,3,4,5]

Energy efficiency measure		Number in group	Percentage saving	Saving (kWh)
Cavity wall insulation	Median	7,970	-7.3%	-1,000
	Mean	7,970	-6.0%	-1,000
Loft insulation	Median	6,130	-2.2%	-300
	Mean	6,130	-2.1%	-400
Condensing boiler	Median	58,150	-7.4%	-1,000
	Mean	58,150	-6.7%	-1,200
Solid wall insulation	Median	1,670	-12.4%	-1,500
	Mean	1,670	-11.9%	-1,700
Solar PV[5]	Median	17,900	-13.5%	-600
	Mean	17,900	-12.9%	-600

Source: NEED, 2018

1. Sample sizes have been rounded to the nearest 10 and consumption to the nearest 100 kWh.

2. Only households with gas consumption between 2,500 and 50,000 kWh have been included.

3. Households with gas consumption readings carried over from the previous year have been excluded.

4. Care should be exercised when interpreting the figures, in particular figures which are based on a small sample size.

5. The results for solar PV show electricity savings, unlike the rest of the table which show savings in gas consumption.

Headline figures presented above are weighted to be representative of the complete housing stock (excluding flats), rather than just the properties which had each of the measures installed in the year under consideration.

Further information about each energy measure is provided below, looking at the analysis of savings made by various property attributes. This provides an opportunity to identify the typical property characteristics which seem to benefit the most from having a particular energy efficiency measure installed.
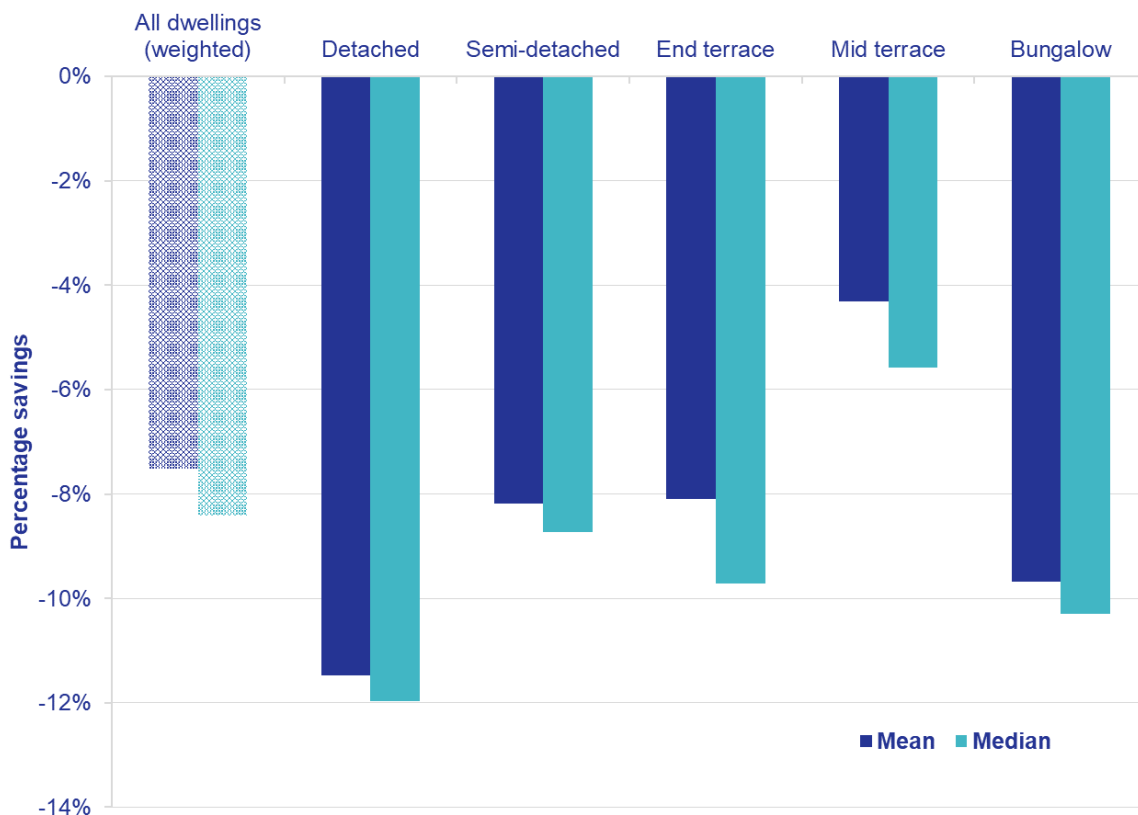
Cavity wall insulation

Typical median savings for properties installing cavity wall insulation in 2015's gas period were 7.3 per cent (representing a saving of 1,000 kWh), this compares to savings of 9.5 percent (1,300 kWh) for cavity wall insulation installed in the 2014 gas period.

According to VOA data, the most common house type in England and Wales is a 3 bedroom semi-detached property. In the 2015 gas period the highest proportion (36 per cent) of cavity wall measures were installed in semi-detached homes.

Figure 4.1 below shows the observed percentage savings in gas consumption for properties installing cavity wall insulation in the 2015 gas period by **property type**.

Detached properties experienced the greatest typical saving (around 10 per cent), with mid terrace properties seeing the smallest reduction in gas consumption (around 3 to 4 per cent) – this pattern has remained unchanged since the 2011 results. It is to be expected that mid terrace properties would see the smallest savings since they only have two external walls, whereas detached, semi-detached and end-terrace all have at least three.

Figure 4.1: Observed savings (weighted) in gas consumption for properties having cavity wall insulation installed in the 2015 gas period, by property type[1,2]

Footnotes:
1 Consumption data from sub-national gas and electricity consumption statistics 2016:
https://www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2016
2 Household characteristics data sourced from the Valuation Office Agency.

Cavity wall insulation appears to have less of an impact on savings when installed in older properties. Houses built pre-1919 have an estimated median gas consumption saving 4 per cent, whilst all properties built after 1919 save a minimum of 6 per cent and a maximum of 12 per cent.

One possible explanation for this pattern is changes in building materials used to meet building regulations[24], which potentially impact the effectiveness of installing an energy efficiency measure. For example, the minimum requirement for loft insulation thickness in buildings has increased over the years therefore newer properties are likely to already be more energy efficient than older properties prior to considering the impact of installing cavity wall insulation.

A high proportion (80 per cent) of households that had cavity wall installed under government schemes in 2015 were owner occupied, which compares to 64 per cent of all properties (as estimated by Experian) in the housing stock that are owner occupied. Cavity wall insulation installed into owner occupied properties had a typical median consumption saving of around 7 per cent.

Loft insulation

Typical median savings for properties installing loft insulation were 2.2 per cent (300 kWh).

Bungalows saw the greatest typical saving (3.8 per cent) in consumption after installing loft insulation. This compares to detached and semi-detached properties which saw the least typical savings of between 1.7 and 1.8 per cent (see Figure 4.2 below).

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[24] Further information about building regulations can be found in Annex C of this publication.

Figure 4.2: Observed savings (weighted) in gas consumption for properties having loft insulation installed in the 2015 gas period, by property type[1,2]
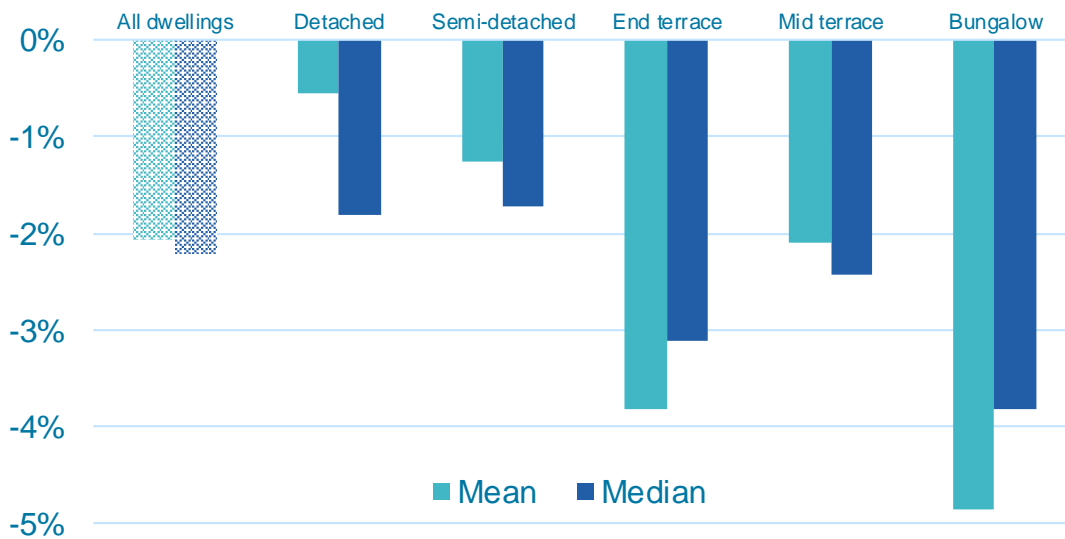
Footnotes:
1 Consumption data from sub-national gas and electricity consumption statistics 2016:
https://www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2016
2 Household characteristics data sourced from the Valuation Office Agency.

When analysing savings as a result of loft insulation installations, the following points need to be considered:

- The loft insulation intervention group covers installations into lofts which had no insulation (virgin loft insulation), and installations into lofts which were already partially insulated (top-up loft insulation). Therefore, households with very little or no existing insulation can expect to save more than the typical savings outlined

- Conversely, properties which already have a reasonable amount of loft insulation, or where the existing insulation is being replaced, are likely to experience smaller savings

- Savings may be underestimated because of the potential for loft insulation to be installed in the comparator group outside of government schemes, but not in the intervention group. This will mean the comparator group may have experienced some savings as a result of insulation which is not accounted for in the intervention group.

Condensing boiler

Typical median savings for properties receiving boilers were 7.4 per cent (around 1,000 kWh).

Data for boiler installations prior to 2009 are not available and therefore historical data have not been included within this publication.

Figure 4.3 shows the observed percentage savings in gas consumption by **property age**.

Installing a condensing boiler appears to have less of an impact at the extremes of the age distribution. Possible explanations for this pattern are:

- Changes in building materials used to meet building regulations[25] potentially impact the effectiveness of installing an energy efficiency measure

- Properties built more recently are more likely to have more efficient boilers prior to upgrading, having been built under newer regulations which require a more efficient boiler. This would reduce the impact of a new boiler

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[25] Further information about building regulations can be found in Annex C of this publication.

Figure 4.3: Observed savings (weighted) in gas consumption for properties having condensing boiler installed in the 2015 gas period, by property age[1,2]
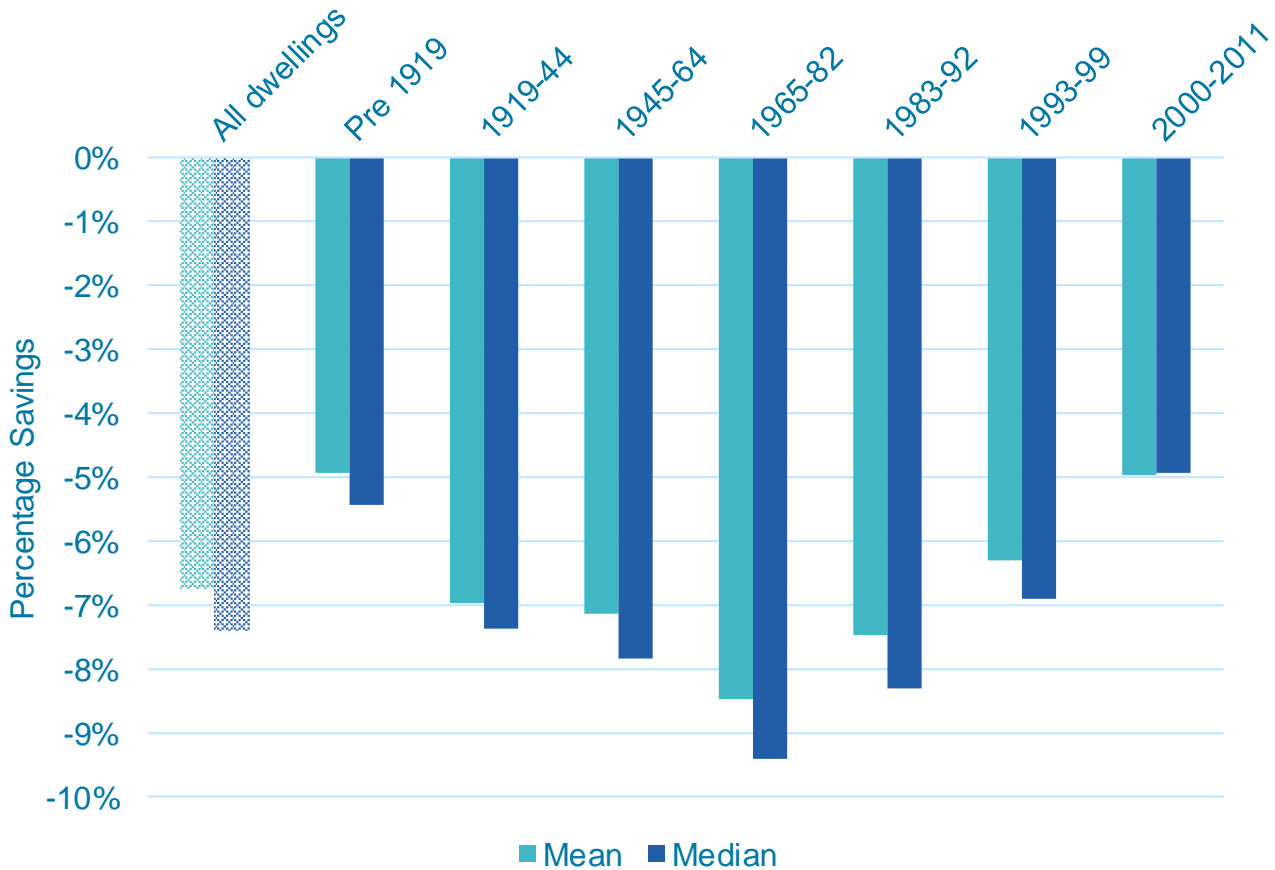
Footnotes:
1 Consumption data from sub-national gas and electricity consumption statistics 2016:
https://www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2016
2 Household characteristics data sourced from the Valuation Office Agency.

Figure 4.4 below shows that the typical savings for properties are greatest for the lower income households. The savings percentage tends to decrease as household income increases. Typical median consumption savings of between 8 and 9 per cent are shown for household incomes of under £20,000, whilst households earning £70,000 and over have typical median savings of around 4 per cent.

Figure 4.4: Observed savings (weighted) in gas consumption for properties having condensing boiler installed in 2015, by income[1,2]
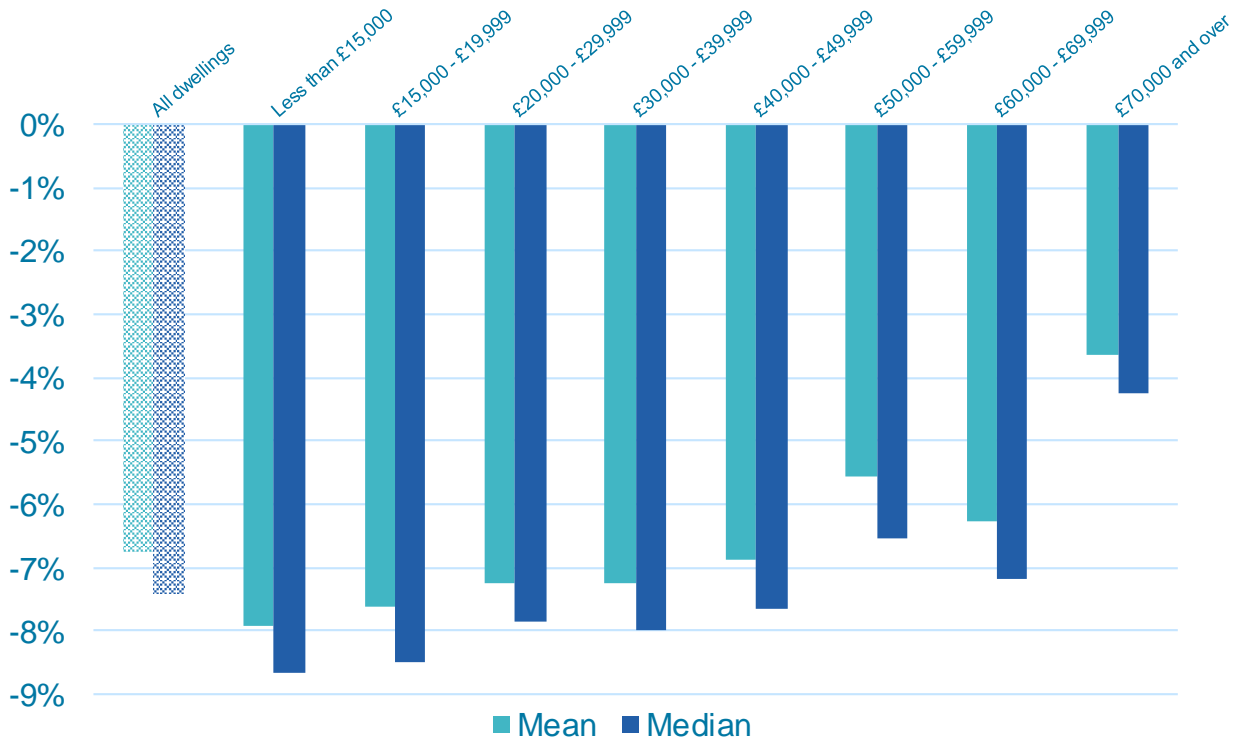

Footnotes:

1 Consumption data from sub-national gas and electricity consumption statistics 2016: https://www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2016

2 Household characteristics data sourced from Experian.

Solid wall insulation

Typical median savings for properties installing solid wall insulation were 12.4 per cent (1,500 kWh). Since the 2012 NEED report, the installation of solid wall insulation has provided the greatest typical gas consumption savings of all the energy efficiency measures compared in this publication.

When interpreting the results for solid wall insulation, the small number of properties in this group should be considered. For 2015, there were approximately 1,700 properties included in the impact of solid wall insulation section of this report. For comparison, cavity wall insulation results for 2015 were based on 8,000 properties.

There are a number of reasons for this reduced group size:

- According to the English Housing Survey, in 2013 only around 7 per cent of all homes have solid wall as opposed to cavity wall, which is recorded as being installed in 60 per cent of properties.

- Solid wall insulation is often installed in flats, which are excluded from the impact of measures analysis as stated in the background section of this chapter

- Solid wall insulation is often installed in properties which do not have gas as the main heating fuel, and therefore these properties are not included in this analysis

- Solid wall insulation is often installed in combination with another energy efficiency measures, such as a new boiler or loft insulation, and so these properties could not be included in the analysis of the impact of solid wall insulation on its own

Solar Photovoltaic (PV)

The effect on a household's mains **electricity** consumption after installing solar PV has also been explored in this chapter. The 2018 publication considers measures installed through Green Deal schemes as well as Feed-in-Tariffs (FITs).

In previous years, **electricity** consumption below 2,500 kWh has been excluded from the impact of measures analysis for Solar PV. In 2018 this exclusion was changed to only exclude electricity consumption below 500 kWh, due to many households having an electricity consumption below 2,500 kWh. This change in methodology for Solar PV means that direct comparisons with previous NEED impact of measures analysis should be made with caution. As electricity consumption in most households is far below 25,000 kWh, the relatively small number of properties with consumption greater than this have been excluded from this analysis, to avoid biasing estimates.

The impact of installing solar PV showed typical median savings in mains **electricity** consumption of 13.5 per cent (600 kWh).

Policy Context

BEIS introduced the Feed-in Tariff (FIT) scheme in April 2010 to promote the deployment of a range of small-scale low-carbon electricity generation technologies in Great Britain.

The FIT scheme subsidises solar PV, hydro, wind, anaerobic digestion installations below 5 MW, and micro combined heat and power below 2 kW. Microgenerators receive guaranteed payments from electricity suppliers based on the amount of electricity produced, along with export tariffs for electricity not used on-site but fed ('exported') to the grid. Unless the microgenerator installs a second electricity meter specifically for exports, 50 per cent of the electricity generated is deemed to be used on-site, and the other 50 per cent, exported to the grid, and export payments are made accordingly.

For more information about the FIT scheme, please visit www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme

Impact of Measures Time Series

This year for the first time a table has been published showing the impact of installed energy efficiency measures as calculated annually since NEED analysis began in 2005[26]. When looking at the impact of energy efficiency measures installed in homes, typical savings for all measure types have declined since 2005. In 2005 cavity wall insulation showed a median typical saving in gas consumption of 10.2 per cent compared with 7.3 per cent seen most recently for 2015. Condensing boiler installations have shown a similar trend over the same period (12.6 per cent in 2005 compared to 7.4 per cent in 2015).

Solid wall insulation and solar PV have shown less of a decline in typical median savings. This may in part be due to the NEED analysis for these measures only beginning in 2010 and 2013 respectively.

Explanations for the general decline in typical savings since 2005 could be due to several factors including:

- An increase in the number of properties which have installed one or more energy efficiency measures outside of a government scheme, increasing the likelihood that properties in the comparator group have an undetected measure installed

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[26] This table is the Impact of Measures Time Series (2005 – 2015) found here: https://www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2018

- A higher proportion of properties are built to modern building regulations, which means the properties have higher energy performance prior to the installation, decreasing the marginal impact of installed measures.

4.3 Impact of installing a combination of energy efficiency measures

This section looks at the impact of installing a combination of energy efficiency measures. The combinations of measures considered in this section are:

- Cavity wall and loft insulation

- Cavity wall insulation and condensing boiler

- Solid wall insulation and loft insulation

- Solid wall insulation and condensing boiler

- Loft insulation and condensing boiler

- Condensing boiler, cavity wall and loft insulation

The limitations of the data sources as outlined in the background section of this chapter also apply to data used for the analysis set out in this section. Only headline figures have been published for all combinations of measures due to the small number of households in these combined groups.

Solar PV has also not been included in this section as savings are based on metered electricity consumption and cannot be compared with the savings in gas consumption achieved by installing one of the other measures (cavity wall insulation, loft insulation, a condensing boiler or solid wall insulation).

Table 4.2 below summarises the median and mean percentage and kWh savings experienced in gas consumption when installing a combination of energy efficiency measures in the same year.

Table 4.2: Summary of changes in consumption (weighted) – combinations of energy efficiency measures installed in the 2015 gas period[1,2,3,4,5]

Combination of measures		Number in sample	Percentage saving	Saving (kWh)
Cavity wall insulation and loft insulation	Median	1,640	-8.5%	-1,000
	Mean	1,640	-8.5%	-1,500
Cavity wall insulation and condensing boiler	Median	700	-14.0%	-2,000
	Mean	700	-14.1%	-2,300
Solid wall insulation[5] and loft insulation	Median	60	-17.3%	-2,000
	Mean	60	-17.9%	-2,300
Solid wall insulation[5] and condensing boiler	Median	190	-15.8%	-2,000
	Mean	190	-13.8%	-2,100
Loft insulation and condensing boiler	Median	800	-12.7%	-1,800
	Mean	800	-9.6%	-1,800
Cavity wall insulation, loft insulation and condensing boiler	Median	280	-14.0%	-1,500
	Mean	280	-12.7%	-2,200

Source: NEED

1. Sample sizes have been rounded to the nearest 10 and consumption to the nearest 100 kWh.
2. Only households with valid gas consumption between 2,500 and 50,000 kWh have been included.
3. Households with gas consumption carried over from the previous year have been excluded.
4. Care should be exercised when interpreting the figures, in particular figures which are based on a small sample size.
5. Solid wall insulation figures should be interpreted with care since they are based on a much smaller number of records and a less diverse housing stock than other energy efficiency measures presented in this report. The combination of solid wall insulation, loft insulation and boiler has not been included as the sample size was very small.

Headline figures presented above are weighted to be representative of the complete housing stock (excluding flats), rather than just the properties which had the combination of measures installed in the year under consideration.

The greatest typical median savings are reported for installing a combination of solid wall insulation and loft insulation (17.3 per cent), however this group had a small sample size so results should be treated with caution. Similarly, results for solid wall and loft insulation were not published in 2017 due to small sample size, so results for 2015 savings cannot be compared to 2014 savings.

The mean and median averages are similar for all installations, with the exception of loft insulation and condensing boiler where the median showed a considerably larger impact

than the mean (3.1 per cent higher). This indicates a skewness in the data, where an unusually high proportion of the households in the sample increased their gas consumption despite the installation of the new measures.

All other combination of installations in 2015 showed lower typical median savings in consumption in 2014 (1 to 9 per cent lower). For example, the combination of cavity wall insulation and loft insulation had a typical median saving of 8.5 per cent in 2015 and 12.5 per cent in 2014.

In terms of absolute change in consumption it is expected that each additional measure installed will have a diminishing return. This is borne out by the data, where the percentage saving for combinations of measures is less than the sum of the measures if installed individually. The only exception to this is solid wall insulation and loft insulation, where the small sample size (60) suggests that the noise in the data may not have been averaged out.

For example, for the combination of loft insulation and condensing boiler, the median saving in gas consumption is 12.7 per cent (Table 4.2). However, adding the impact of each single measure together (2.2 per cent for loft insulation and 7.4 per cent for condensing boiler) results in a sum of 9.6 per cent (see Table 4.1). This is lower than the saving presented in Table 4.2 for the installation of both measures in the same year and suggests that installing more than one measure can have multiplicative effects.

4.4 Scotland

This section outlines the impact of installing energy efficiency measures on a household's gas consumption solely for properties in Scotland.

For editions of the NEED publication up to and including 2016, the Scottish analysis can be found in an annex published alongside the main report. Modelled data from Experian have been used for property attributes and household characteristics in this analysis except for property type, where data from the Scottish Assessor (who hold property attribute data for the purpose of valuating properties) has been used. Comparisons between the Experian and Scottish Assessor data shows that property type in both data sets are broadly in line.

The use of modelled data for property attributes in Scotland allows analysis to be undertaken. However, it also increases uncertainty in the estimates. Therefore, these results should be treated as provisional and interpreted with caution.

Headline results

This section sets out headline results for the impact of installing a single energy efficiency measure in a household in the 2015 gas period. It covers cavity wall insulation, loft

insulation, solid wall and condensing boilers[27] and for the first time installations of photovoltaic panels.

Table 4.3 below shows the savings experienced in households' gas consumption for cavity wall insulation, solid wall insulation, boiler installations, loft insulation and solar panelling installed in the 2015 gas period. It shows that the greatest typical saving is seen for properties installing solid wall insulation, with a typical saving of 13 per cent, or 1,600 kWh. Properties installing cavity wall insulation saw a typical saving of 7.5 per cent, which represents a saving of 1,100 kWh, whilst properties installing a new boiler saw a typical saving of 7.5 per cent.

The typical saving from installing solar photovoltaics is 5.2% in Scotland, which is considerably lower than the typical saving in England & Wales of 13.5%. This is likely to be due to Scotland having fewer sunshine hours with lower intensity than England & Wales.

Table 4.3: Summary of observed savings – single energy efficiency measure installed in the 2015 gas period[12345]

Energy efficiency measure		Number in sample	Percentage saving
Cavity wall insulation	Median	3,390	-7.5%
	Mean	3,390	-7.2%
Loft insulation	Median	2,440	-2.2%
	Mean	2,440	-1.7%
Solid wall insulation	Median	250	-13.0%
	Mean	250	-15.6%
Boiler	Median	3,730	-7.5%
	Mean	3,730	-7.2%
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Solar PV	Median	1,700	-5.2%
	Mean	1,700	-4.9%

1. Only households with gas consumption between 2,500 and 50,000 kWh have been included.
2. Households with gas consumption readings carried over from the previous year have been excluded.
3. Care should be exercised when interpreting the figures, in particular figures which are based on a small sample size.
4. The results for solar PV show electricity savings, unlike the rest of the table which show savings in gas consumption.
5. Sample sizes have been rounded to the nearest 10 and consumption to the nearest 100 kWh.

[27] Estimates of savings from installations of loft insulation are based on professional installations only, as recorded in HEED. It does not cover properties which have had loft insulation installed by the homeowner themselves (DIY loft insulation) or properties which had their loft insulated when built (as built).

Detailed results by property attributes and household characteristics have not been included in this report due to the increased impact the uncertainty surrounding these estimates has on individual groups. The methodology used for calculating the estimates means that any mismatches in properties being matched with similar properties as a result of modelled data not being accurate will be accentuated when results for different break downs are considered. However, like results for England and Wales, households experience a range of savings. The actual savings experience by households will depend on a variety of factors including the consumption in a property before the measure is installed, physical attributes of the property and how householders use energy.

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